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DEC 31 1931

Engineering and Mining Journal

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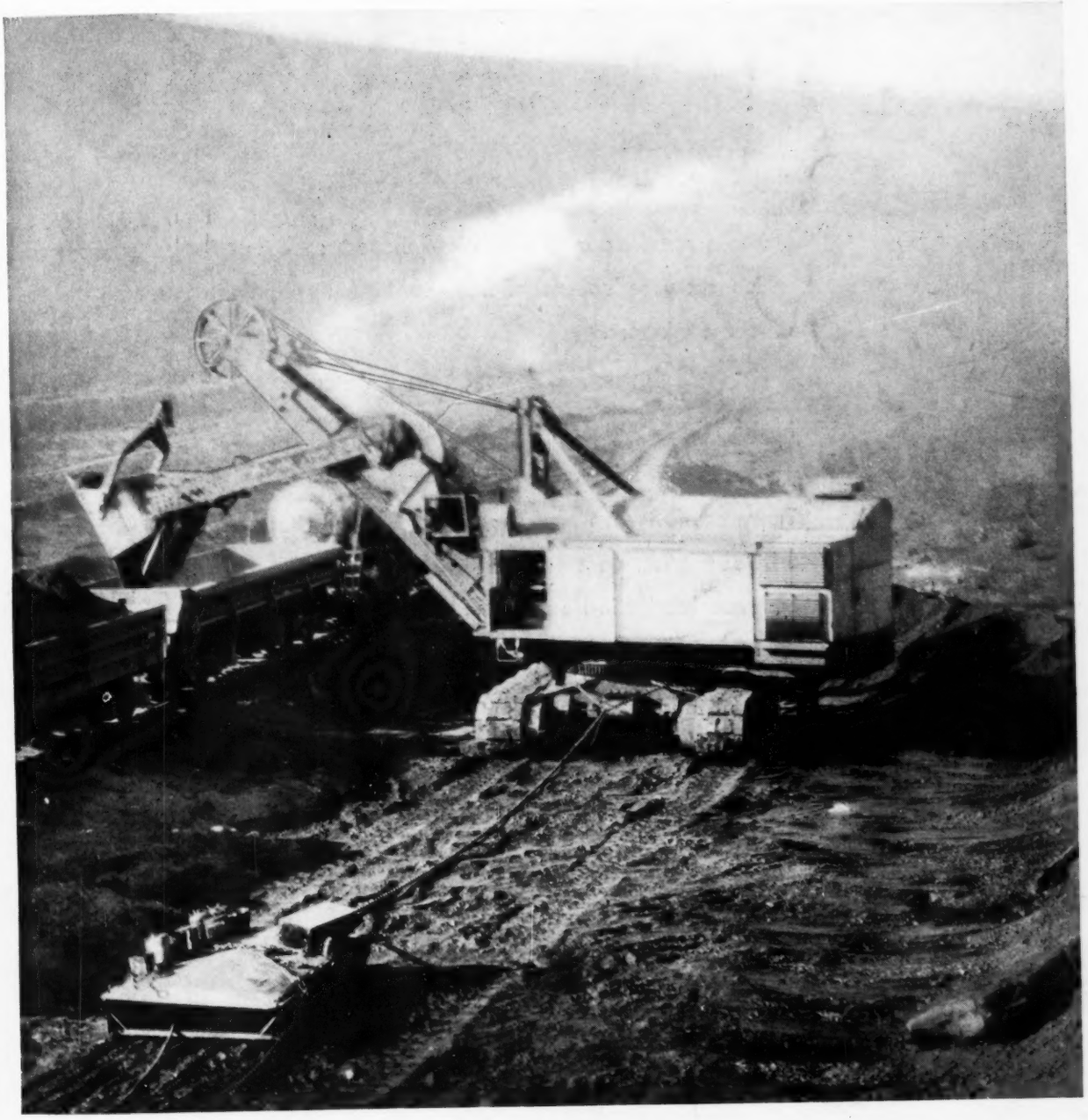

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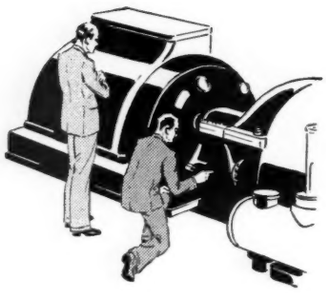

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Engineering and Mining Journal

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New York

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Cover Illustration Courtesy of Bucyrus-Erie Company

McGraw-Hill Publishing Company, Inc.
330 West 42d Street
New York, U. S. A.
Cable Address: "Machinist, N. Y."

CHICAGO, 520 N. Michigan Ave.
ENGLAND, Aldwych House, Aldwych, London, W. C. 2
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Published semi-monthly. Price in the United States and possessions, 25 cents (U. S. Currency) for copy; $4 per year. In all other countries, $20 per year—24 issues. Entered as second-class matter, June 20, 1879, at the Post Office, New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

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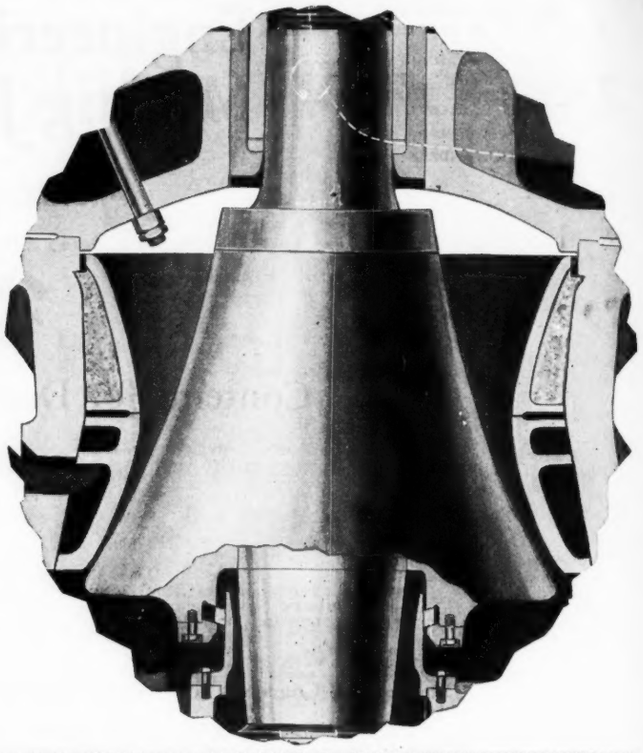

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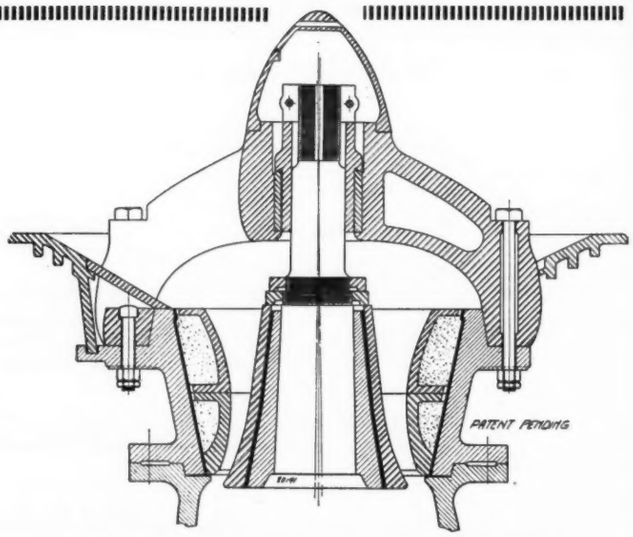

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Engineering and Mining Journal

McGraw-Hill Publishing Company, Inc.

December 28, 1931. A. W. ALLEN, *Editor* Vol. 132—No. 12

Improved Technique in Non-Metallic Processing

ALTHOUGH application of ore-dressing fundamentals to the treatment of the non-metallics has expanded markedly in the last few years, further effort in this direction is desirable. Substantiation of this preachment, if it be termed such, is found in the abstract, that appears elsewhere in this issue, of a paper by Mr. R. G. O'Meara, in which he points out that the recent introduction of hydraulic classification has added 81,000 tons to the annual production of the land-pebble phosphate district in Florida. Other non-metallics, such as fluorspar, barite, feldspar, and kyanite, offer equally important opportunities for similar investigation, because, even where the difference in specific gravity between the gangue and valuable mineral is slight, some advantage may be taken of variations in shape or size of particles in the size ranges commonly considered below those for commercial screen separations. For instance, in the paper cited, reference is made to the use of hydraulic sizing to remove flake grains in a classifier. In the Florida phosphate fields these grains are mostly particles of clay that are almost as hard as shale, and do not disintegrate in the washing operations. Classification might therefore be expected to prove of value in other non-metallic districts, to remove flakes of similar materials that cannot be separated by any of the customary methods of screening.

In the conclusion of his paper, Mr. O'Meara states that hydraulic sizing should be considered as a transitory process, to be used pending the development of more complete recovery processes. This statement refers presumably to the application of the flotation process in the phosphate industry, the general use of which has been retarded by patent difficulties. Commercial flotation of phosphate, as well as of fluorspar, is, however, an accomplished fact. But, even in respect to these two minerals, separations are not considered particularly successful from a metallurgical standpoint when the gangue is limestone.

Increased recoveries in the non-metallic mineral industries, with the beneficial economic results that must accompany such improved practice, will undoubtedly be effected largely by raising the recovery of the finer-sized particles, which, in many instances, now go to waste. Research to develop new applications of the flotation process in the treatment of the non-metallic minerals is therefore most important, particularly of those associated with a limestone gangue.

Insulation, Air Conditioning and the Mining Industry

MANY interesting facts about the insulation of houses are revealed in a recent report issued by the United States Department of Commerce. Tests show that, in an ordinary house with no special insulation, 40 to 60 per cent of the lost heat passes through walls, floors, and roofs; 15 to 30 through cracks and crevices; and 20 to 25 per cent through doors and windows. Sufficient evidence is also available to prove that an insulated house on hot summer days registers a room temperature 10 to 15 deg. F. below that of an ordinary dwelling. Experiments made at the University of Illinois indicate that, with the same room temperature in two houses—one insulated, the other without such protection—a greater sense of comfort is experienced by the occupants of the former. This is explained by the fact that in the winter time the interior surfaces of the walls and windows in an insulated house, being of higher temperature, have a less chilling effect on the body. A further advantage derived from insulation is reduced fire hazard. A sudden drop in outside temperature does not involve putting an abnormal strain on the heating plant, with resultant scorching and damage by fire.

Disclosure of facts in recent years has brought realization that the proper insulation of dwellings is really no luxury, to be indulged in only by those who can satisfy a craving for comfort without counting the cost. Proper insulation has been definitely proved to be a paying investment, disregarding the added comfort and other benefits difficult to evaluate. Many different types of insulating materials are available to meet increasing demand, to the advantage of producers of some of the non-metallic minerals suitable for the purpose.

Adoption of air conditioning promises to give further impetus to the consumption of insulating materials. Already an accomplished fact in modern theaters, the system is now being introduced in restaurants, offices, and stores. It has met with the enthusiastic approval of travelers by rail, and a wide acceptance of the innovation in the field of residential building is being predicted. Proper insulation is essential to keep construction cost of a comfortable and economical dwelling at a reasonable figure. The mining industry is vitally interested in this development. Important outlets will thus be created for

non-ferrous metals as well as for insulating materials, in machinery and equipment.

According to the Presidential Committee on Reconditioning, Remodeling, and Modernization, three million homes in the United States are in need of repair. Vigorous efforts are being made to release credit for this work, as well as for the promotion of new building; so the next few years may present a picture of intense activity in this field. During previous economic crises the opening of new industries has proved important in re-establishing normal conditions. A new and more efficient building program, though perhaps not as spectacular a development as was the rise of the electrical industry, the automobile industry, or the radio industry, may provide one of the best means for a speedy recovery from business stagnation.

Mine and Mill

Construction Supervision

THE architect of the old school supplied the plans of a building only. He was willing to give professional advice to his client and to those assigned the job of translating his ideas on comfort, convenience, permanence, and appearance into tangible form; but the client had to look elsewhere for someone to take charge of construction. If the contractor or his workmen erred in the interpretation of the plans, skimped in service or material, or sacrificed material or stability to extra profit, the architect was available, at intervals, to report on progress, to detect the shortcomings of the contractor, and to suggest what should be torn down to correct a mistake the result of inferior craftsmanship. The client welcomed the intervention of the specialist, but he had to wait that much longer for his house and to pay for changes in original plans.

A new order has replaced the old. The prospective house owner entrusts both design and supervision of construction to the architect, with the result that time and money are usually saved, worry over details of which the average citizen has no technical knowledge is avoided, and disappointment and recrimination are reduced to a minimum. Why not a wider application of the same idea to the design and construction of underground and surface plants? The time has surely come when the specialist should expand his activities beyond the confines of purely consulting work. Like the architect, he should be an expert in research and design; but he, and he only, should be the one to translate the design into practice, as exemplified in an operating mine or plant. To advise and then retire from the scene is as futile a proceeding in mining and processing as it proved to be in architecture.

In the order of their importance, the citizen wants a comfortable and attractive home, easy to manage, economical to pay for and keep in order. The mining company wants, first of all, a mine and plant that will operate efficiently and profitably. To divorce design from construction—to take the ideas of a specialist and put them in the hands of a construction gang under non-technical or semi-technical authority and supervision—is to invite unnecessary expense, inevitable delay, and disappointment. The alternative—unified design and construction—encourages greater accuracy in preliminary work, and the application, while construction proceeds, of those niceties and refinements in equipment layout that usually improve ultimate results and bring satisfaction to all concerned.

Extraction Responds to Careful Technique

THE need for an analytic appraisal of the details of a metallurgical operation is well illustrated by a table that accompanied the excellent article in the recent Homestake issue of this publication, by that distinguished technical veteran Mr. Allan J. Clark. The title of the table was "Leaching Extraction, by Grades, of a Typical Sand Charge." The data, more than sufficient to provide texts for a series of helpful and stimulating dissertations on the physical aspects of a hydrometallurgical process, were of a type that seldom form part of a descriptive article.

A study of several reports on leaching tests discloses the fact that rarely does the investigator carry his work to a scientific conclusion. An ore is ground to pass a certain mesh. Experimental lixiviation is successful or unsuccessful. If unsuccessful, the idea of gravity leaching is generally abandoned. Seldom is sufficient attention paid to the distribution in the charge of those elements that are refractory from the mechanical standpoint—that interfere with the proper passage of the lixiviant. Rarely does the investigator realize that, although a comparatively high percentage of amorphous slime may not interfere with the leaching of a charge of ore that has been dry crushed and evenly distributed in the vat, the practice of grinding in water liberates such slime and causes it to agglomerate to an extent prohibiting its even redistribution among the coarse crystalline particles. Thus when battery pulp is delivered direct to a leaching vat, the settled sand invariably contains seams of slime that cause short-circuiting and poor extraction. In an attempt to remedy this deficiency, early practice provided for double treatment, insuring the disintegration and mixing of the material while en route from one vat to the other.

Homestake practice has been based on a scientific study of all the factors influencing the efficiency of extraction. The battery pulp is carefully classified into crystalline and amorphous material. The physical character of the product marks the line of demarcation, not the mesh size. Amorphous 200-mesh slime is kept distinct from 200-mesh sand. As a final precaution, the decolloided pulp is delivered to a leaching vat filled with water and provided for annular overflow so that contamination of the charge with seams of non-crystalline fine material is at a minimum. Metallurgical results, in consequence, are worthy of special attention, particularly in regard to the high (90 per cent) extraction of gold from the minus 200-mesh material, by means of simple lixiviation by gravity. This very fine sand represents one-third, by weight, of the charge; so that, based on production figures for the first six months of 1931, 260,000 tons is being treated thus per annum, at low cost and high recovery.

In these days of intensive effort to mine and mill low-grade ore at a profit, no time is wasted that is spent in an elaborate study to determine to what extent a refinement

in practice of demonstrated logic and value can be applied to any single portion of the ore. Work at the Homestake, which has proved successful from the economic as well as from the metallurgic standpoint, may well be taken as a foundation for a program of research and experimentation to determine the best and most economical method of treating any gold ore of similar type and grade.

Industrial Accident Compensation Awards

THE high industrial-accident compensation rate in California is attributable to liberal legal provision favorable to awards, to an unsatisfactory administration structure, and to a relatively high accident rate. Apparently, it discriminates against the employer. In a recent award a man who fell from a truck he was driving, and who broke his wooden leg as a result, applied for and received compensation. The award was contested, and by a four-to-three decision the State Supreme Court ruled that a wooden leg is personal property and not compensable for damage. The decision was a just one, yet the fact remains that three members of the court were disposed to support an absurd claim.

Industrial accident compensation is a wholesome provision when the conditions under which it is granted are fair to employee and employer. Some of the risk involved in industrial employment must necessarily be carried by the employee. Under present conditions the entire cost of compensation is paid for by the employer. This is a heavy burden on industry. Notwithstanding, new provisions become law that have for their objectives the widening of the incidence of compensation and the liberalizing of its provisions in favor of the employee. A new and simple law, fair alike to employee and employer, is needed, the administration of which should be in the interests of both parties. Each should cooperate to prevent accident and to reduce the accident rate. If the law can be simplified and its administration costs reduced, the accident compensation rate in California should be materially lowered.

Helping to Suppress Tuberculosis Is More Than a Duty

MINING has its particular hazard, in common with many other industries, and the fact must be faced that tuberculosis, acquired underground or in surface plants where dust is not allayed, is a cause of preventable illness and mortality. Vigorous combative and educational measures are taken by the leading mining companies, with excellent results; but the parish of *Engineering and Mining Journal* covers a multitude of properties where the risk is recognized, but where no vigorous corrective action is taken. The "skeleton in the cupboard" is left alone, ignorance of simple truths prevails, and the result is misery, suffering, and financial loss to all concerned.

No other ailment has been reduced, in the extent of its ravages on humanity, by the persistent dissemination of educative propaganda, to such a degree as has tuberculosis. Research and medical science have combined to simplify diagnosis and treatment, and no serious illness is more amenable to care and attention. The amazing fact persists, however, that the individual whose health and happiness is threatened fails too often to heed the warnings of approaching trouble. The early symptoms in most instances are unmistakable, but often indiscernible to close friends and relatives—an inexplicable fatigue, loss of body weight, and a persistent though perhaps insignificant cough. A cure is almost certain if early precautions are taken; and no remedial action is too drastic if this can be effected.

In its campaign against phthisis, the National Tuberculosis Association has met with signal success, as statistics indicate. But it cannot seek out incipient invalids. To them and to executives who have the health of their employees at heart we suggest that advantage be taken of the excellent advice contained in circulars and pamphlets obtainable by request from the Association's headquarters, which are at 370 Seventh Avenue, New York City.

At this season of the year we are reminded to use Association seals on our letters. Funds are needed, and a generous response from all mining men should be assured. To assist in the suppression of turberculosis in the mining industry and in those affiliated with it is more than a duty.

Electric Shaft Elevators Insure Safety and Economy

R. I. C. Manning
Associate Mining Engineer,
U. S. Bureau of Mines Safety Station,
Salt Lake City, Utah

ELEVATOR-TYPE cages operated from cage or hoist, or from both, are economical and safe. No hoistman is needed. The operator or hoistman is also the cager, and the normal operation of the hoist is accomplished from the cage, especially when men are being transported. Installations of this type were completed in Arizona by Inspiration Consolidated, Nevada Consolidated, and Phelps Dodge in 1915, 1919, and 1929, respectively. Operating officials are pleased with the economical and safety features of these hoists.

Ability to signal the hoistman from the cage, at rest or in motion, facilitates the safe handling of men. Absolute control of the hoisting equipment by the cager, as in the operation of the elevator, is advantageous. Much higher speeds with safety are possible in the transfer of men and materials than with equipment requiring a hoistman and at least one cager. Signaling is avoided. Because of low tensile strength of electrical conducting cables, 1,000 ft. seems to be the limit of travel for elevators of this type. This depth of shaft would require about 550 ft. of multi-conductor cable suspended beneath the cage, and also at a point midway of the shaft. With greater lengths the cable might pull apart, because of weight.

Inspiration Consolidated installed an electric man-hoist at Inspiration, Ariz., in 1915. This machine is, in fact, a modern passenger elevator with safety devices such as are employed for service in many tall buildings, with the added feature that it can be operated either from the hoist or from the cage. The cage, used for the movement of men and supplies, has a travel of 700 ft., with a lifting capacity of 7,500 lb. at 700 ft. per minute, but is arranged for an ultimate travel of 1,150 ft. It is of the double-deck type, about 5 ft. square, and capable of holding twenty men. The decks are inclosed on two sides by heavy sheet-iron panels, and on the other two sides by collapsible steel gates, each provided with contacts connected in series with electrical-control apparatus, arranged so that all four gates must be closed before the operator can start the cage. Likewise, should any gate be opened while the cage is in motion, power will be immediately cut off from the hoisting machine, and the cage will stop.

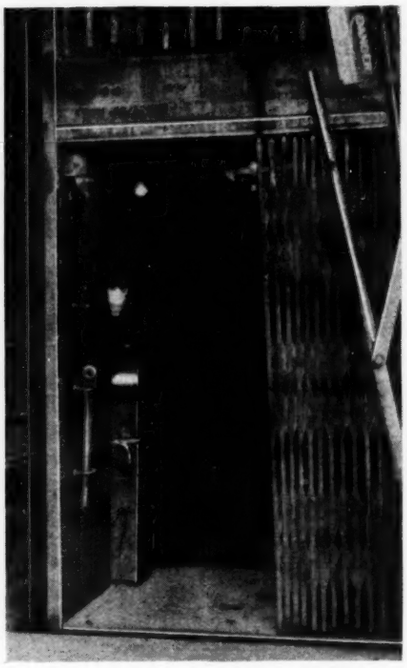

Fig. 1—Control arrangement on lower dock of elevator at Ray

The cage, in charge of an experienced operator, is operated by means of a master switch on the lower deck. Time is thus saved that would otherwise be consumed in the transmission of signals from the shaft to the engine-man in the hoist house. However, the cage may be operated from the hoist house (by the man in charge) if a duplicate of the master switch is provided in the cage. A mechanical indicator keeps the engineer advised as to the position of the cage in the shaft. Telephonic communication is also provided between the cage and hoisting house. At the top of the headframe a wedge-clamp safety device is actuated by a centrifugal governor, provided with a switch that automatically governs the speed of the cage in the event of a predetermined overspeed. Should the cage continue to accelerate after this switch has cut off current from the hoist motor, the governor will mechanically trip the wedge-clamp safety device, applying clamps to the guide rails until the cage is brought to a stop. This clamp is on the bottom of the cage.

Two long-stroke hydraulic buffers at the bottom of the shaft are also designed to bring the cage to gradual stop from full speed without shock or injury to the passengers. This is effected by the displacement of oil in the buffers at a calculated rate of retardation, regulated by the escape of oil from one chamber of the buffer to the other. The hoist is automatically slowed at top and bottom of the shaft by a stop-motion device operated from an extension of the drum shaft of the hoisting machine. Additional safeguards include limit switches, beyond the range of the stop-motion switch, designed to stop the hoist automatically if the cage or counterbalance passes the normal limits of travel, in the superstructure or headframe. The hoist is of the single-reduction herring-bone gear type with a winding drum 72 in. in diameter, driven by a 160-hp., 6-pole motor with interpoles, operating at a speed of 385 r.p.m. A powerful band brake, applied by a heavy spiral spring, and a weight serve to hold the cage immovable when current is interrupted. A Francke flexible coupling connects the motor shaft to the pinion shaft. Power for operating the hoist, generated at the Roosevelt Dam, is received at the transformer substation at 44,000 volts, which is stepped down to 2,200 volts. A 3-phase General Electric induction motor direct connected to a G.E. variable-voltage direct-current generator mounted on the end of the motor-generator set furnishes the power used for the controller magnetic switches, brake, and shunt fields of the hoist motor and generator.

The Ward Leonard system of control is used, the distinctive feature being that of varying the voltage on the hoist-motor armature. With most systems this is accomplished by a resistance connected in series or in series-parallel with the hoist-motor armature. With the Ward Leonard system the voltage is changed by supplying the power from a variable-voltage generator with field regulated by rheostat under the control of the operator. The control apparatus consists of: (1), controller; (2), master switch; (3), stop-motion switch; (4), limit switches, safety switch, and others. In addition to electrically operated de-

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vices, the following mechanical devices are furnished: (1), safety knife switch; (2), slack-cable switch; (3), overrun limit switches.

The safety switch, mounted close to the master switch, is used by the operator in the event of emergency. The opening of this switch interrupts the circuit of the main-line switch, which, in turn, interrupts current to the hoist and brake, thereby stopping the hoist. The slack cable switch is mounted under the hoisting drum and opens when the hoisting ropes become slack. Overrun limit switches are provided to stop the hoist and to apply the brake if the cage travels beyond the normal limits of travel. They are mounted so that one will be operated by the cage and the other by the counterbalance. The shaft is vertical, 800 ft. deep, concreted throughout, and equipped with steel guides. Collapsible steel gates are at all levels. Both decks of the cage can be loaded and unloaded simultaneously at all levels.

A counterbalance travels in a separate compartment. Both counterbalance and cage are attached to the same drum by means of 1⅛-in. steel cables. The power cable, 450 ft. long, is attached to the bottom of the cage and also at a point midway of the shaft. Specifications are: 30-conductor 16 B. & S. Flexible, 1/32 in. wall, 30 per cent para-rubber taped 3/64, belt 30 per cent para-rubber taped, and two W.P. braids, manufactured by the Safety Cable Company. The average life of these cables (three shifts daily) is four to five years. This cable carries light circuits for the cage, telephone, and controller. The elevator has been operating almost continuously for sixteen years without trouble that could be directly attributed to it. It has paid for itself several times in economies of operation and is used for the movement of men and supplies on all shifts.

The Nevada Consolidated electric man-hoist at Ray, Ariz., except for minor changes and additions, is essentially the same as the Inspiration Consolidated hoist. The cage has a travel of 675 ft., with a lifting capacity of 7,500 lb. at 800 ft. per minute. A mechanical indicator keeps the hoistman advised of the exact position of the cage in the shaft. An annunciator with numerals for each level, provided on the bottom deck of the cage directly in front of the control or master switch, simplifies calling for the cage. The hoist is of the single-reduction herring-bone gear type, with a winding drum 60 in. diameter and 72 in. face, driven by a 150-hp., 440-volt, alternating-current motor. Two 1⅛-in. cables attached to opposite sides of the drum, arranged so that one is wound on as the other is wound off, pass over 10-ft. diameter sheaves to the cage and counterbalance. Four No. 14, six-conductor cables, about 380 ft. long, are attached to the bottom of the cage and to a point about midway of the shaft. Two are used for the control, one is for the telephone and light, and the fourth for the annunciator. The average life is four to five years. The shaft is vertical, 675 ft. deep, lined with concrete and steel. Both cage and counterbalance travel on steel guides. Level stations are also lined with steel and concrete and provided with steel fire doors. The stations, as well as the surface, are arranged so that both decks of the cage can be loaded or unloaded simultaneously. The station openings into the shaft are completely closed by sliding steel doors, provided with switches connected so that all doors must be closed before the elevator can be operated. Steel emergency exit doors in the side of each deck enable passengers to escape into the manway compartment of the shaft in the event of emergency. A steel ladder runs the full length of this compartment. This installation has been in operation continuously since 1919. It is used solely for the transportation of men, 37 of whom can be transported on the two decks—18 on the top, and 19 on the bottom. No trouble has been experienced.

The Phelps Dodge electric man-hoist at Morenci, Ariz., is radically different from the two hoists described in the foregoing. The Joy traction elevator consists of a 140-hp. gearless-type direct-current motor, direct-connected to a rope-drive sheave with each side ex-

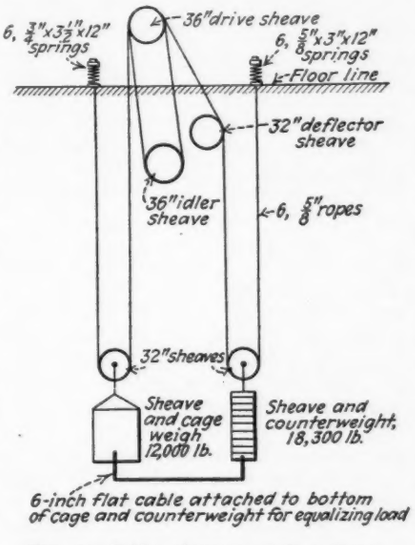


Fig. 2—Cable, sheaves, and counterweight for man-hoist at Morenci

tended, providing two drums on which two solenoid brakes are mounted. Motor, sheave, and brake drums make a unit on a common shaft, supported by two pedestal-type bearings, one on each end, all mounted on a common bedplate.

Six hoist ropes pass once over the hoist sheave, then around an idler sheave, then over the drive drum again, over a 32-in. sheave, and are brought back and dead-ended on six compression springs near the hoist motor. The other ends of the cables go direct from the drive sheave, pass around a 32-in. sheave on the cage, and are brought back and dead-ended near the hoist motor by means of six compression springs.

Power for the hoist motor is supplied from a motor-generator set, with 110-kw., direct-current generator, driven by a 175-hp., 2,200-volt, 3-phase, induction motor with pushbutton control. Its armature is direct-connected to the armature of the hoist motor, which has permanently excited fields. The fields of the generator are dead when the hoist motor is not running, and are excited, in whichever direction the hoist motor is to run, only when the motor is to operate. This arrangement provides regenerative braking on slowdown of the hoist motor, or whenever the hoist motor is run overspeed by unbalance of the counterweight and load.

The solenoid brakes, of 1-in. stock, 6¼-in. diameter, with five turns, are set by four helical springs of circular cross-section, working under compression. When the field of the generator is excited, power is applied to the solenoid magnets on these brakes, and the brakes are released. When the excitation is taken off the generator field, or when the power fails or the car runs into the limit switches, cutting off the hoist control, the solenoid magnets are de-energized and the springs apply the brakes.

Two limit switches are provided for the over-travel of the cage, operated by gear drive from the idler sheave. These switches are provided with four contacts each, the first of which operates when the cage has over-traveled 4 ft. in either direction. This reduces the speed of the hoist by de-energizing a point on the cage controller, slowing down the hoist. The second point de-energizes another point, further slowing down the hoist. The third point carries this process still further, and the fourth point "kills" the generator field, sets the solenoid brakes, and puts the hoist motor on dynamic braking position. The last or stopping point is 8 ft. above the collar of the shaft and 8 ft. below the 14th level. A greater distance to stop would be more desirable, but the space was limited to the 8 ft. taken. After the cage has run into the last limit switch it cannot be moved further in that direction by the operator, but it may be moved back in the opposite direction.

Excitation for both the generator and the motor is provided by a 9-kw., 250-volt exciter, mounted, with a 0.45-kw. series exciter, on the shaft of the motor-generator set. This series exciter, excited by a shunt current from the main generator leads, helps to boost the excitation of the generator, depending on the generator load and being at a maximum boost when the generator is overloaded, and has no effect at no load on the generator. When the generator is regenerating power, the series exciter is in opposition to the main exciter and bucks the field on the generator, causing

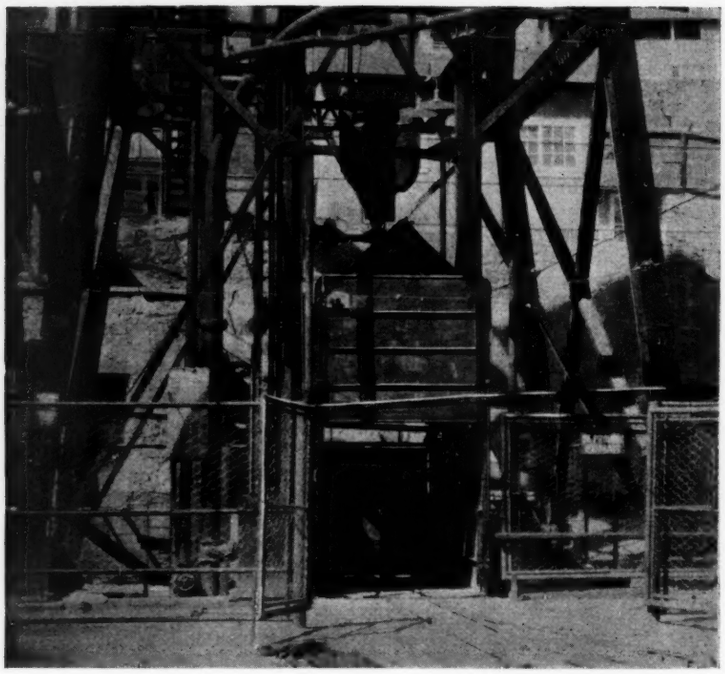


Fig. 3—Shaft collar at Morenci; cage at surface

it to accelerate and make the regeneration more effective.

Operation of the hoist, motor, and generator is controlled by a panel equipped with relays and control devices, insuring semi-automatic operation and preventing too-rapid acceleration or too-rapid stopping of the hoist motor.

The hoist is controlled from the cage in normal operation. A small master controller with seven points of speed for both hoisting and lowering is almost flush with one side of the cage. When this is thrown on the first speed point, the brakes are released through relays and the cage starts. Higher speeds may then be given until the cage is traveling at its maximum speed of 400 ft. per minute. Another controller, at the collar of the shaft, may be used after throwing the control circuit to it by means of a double-throw switch mounted in the generator room. This makes the cage controller inoperative. While the cage control is being used, the shaft-collar control is inoperative. The shaft-collar control is used when lowering or raising excessive weights where the safety factor of the hoist would be considerably lowered.

The automatic control panel in the generator room is provided with a relay that makes the hoist motor inoperative until the motor-generator set is running at full speed. If the power to the motor generator should fail, this same relay would open the main circuit breaker in the leads running between the hoist motor and the generator. The hoist motor would be thrown on to dynamic braking and the solenoid brakes on the hoist drum would be applied. Should the power fail, the field on the hoist motor would gradually die or the excitation fail, and dynamic braking would then be only as effective as the residual magnetism of the hoist motor fields allowed, though this probably would be considerable.

The field of the hoist motor is permanently excited, through an economy resistor, so that the current in the fields may be adjusted to the exact strength required. Also, in this field circuit is a field protective relay. Should the field circuit of the hoist motor be interrupted, this relay would open the control circuit of the hoist motor, apply the solenoid brakes, and throw the hoist motor on to dynamic braking, thus stopping and holding the hoist.

The solenoid brake on the hoist drum is controlled by a solenoid brake relay with two windings. One of these is in series with the hoist-control circuit that applies the field to the generator and starts the hoist operating. As soon as the generator field is excited the solenoid brakes release. The other coil is connected direct on to the armature of the generator. So long as the generator is excited, this coil holds the relay closed and keeps the solenoid brakes in an off position. Therefore, the brakes cannot be applied while the generator is delivering power to the hoist motor.

Inasmuch as the generator, because of residual magnetizer or series field, might deliver power to the hoist motor when the shunt field is not excited and the cage control is in an off position, a "suicide" connection connects the generator field differentially to the generator terminals by means of the generator shunt field control switches in an off position. The generator then excites its own fields in a reverse direction until it kills itself, and any heavy flow of current at a low potential is eliminated. However, the generator would kill itself too soon if it were thrown directly on to the "suicide" connection and the hoist would be stopped roughly. A neutralizing relay is therefore provided, operated by a coil connected direct across the generator leads. The "suicide" connection is held open until the generator field dies down, as a result of the hoist controller being thrown to the off position. When the field dies down to a predetermined amount, the neutralizing relay operates and the generator is thrown to the "suicide" connection and kills itself.

The hoist would operate satisfactorily if the operator would apply the power to the hoist motor gradually, by going slowly from point to point on the controller; but if he should start too quickly or throw the controller suddenly off, the hoist would operate roughly. To overcome this, a damping motor with a flywheel is provided, making it impossible for the operator to start or stop the cage too quickly, regardless of the manner in which he throws the controller. This damping motor armature is connected in parallel with the shunt field of the generator. The shunt field of the damping motor is separately excited by means of the switch controlling the solenoid brake. When the solenoid brake is excited, and the brakes are in an off position for the operation of the hoist motor, the field of the damping motor is excited, and it runs. When the solenoid brakes are set and the brake coils are dead, the field of the damping is dead and the motor is at rest. Then it has no counter electromotive force, and its resistance is small. When excitation is applied to the shunt field of the generator, most of it will pass through the armature of the damping motor. The damping motor, being separately excited, will begin to run, and as it gradually comes up to speed will develop counter e.m.f. equal to the voltage being applied to the shunt field of the generator. The current will gradually be diverted from the damping motor to the shunt field of the generator, and the generator will gradually build up its voltage and start the hoist motor with an even acceleration.

The reverse is true on stopping the hoist motor. In this case the flywheel of the damping motor keeps it running as a generator, and the rapid variation of the shunt field of the hoist generator is smoothed out and the field is supplied by the damping motor until the damping motor gradually stops. However, if the damping motor did not have resistance in series with its armature, it would act as a short circuit for the generator-field current, and too much of the field current would pass through the damping motor; so a permanent resistance was installed in the damping-motor armature circuit. With this there would still be too much current through the damping motor on starting the hoist motor, so additional resistance was added to the armature circuit. This would be too

much resistance after the hoist motor had started, so a relay was installed to cut this resistance out after the hoist motor had reached a certain speed. This relay is called the accelerating relay and is controlled by two coils, one across the armature of the generator and one across the shunt field of the generator. Should the controller of the hoist motor be thrown off suddenly, the coil across the armature of the generator would hold the relay until the voltage of the generator had dropped a certain amount. This relay controls the speed of the hoist motor. In spite of all these automatic features, the control might be thrown on too suddenly and the hoist started too rapidly. An additional resistance was provided in the generator field circuit ahead of all these devices. This resistance is controlled by the generator voltage, the operating coil being across the generator armature. This relay cannot work until the voltage of the generator has built up to a point corresponding to a cage speed of about 220 ft. per minute. After this point the control of the speed of the hoist motor is automatic and the hoist comes up to full speed at 400 ft. per minute.

All the relays relating to the speed of the hoist motor are indirectly controlled by the operator from the cage. The generator field, and consequently the direction in which the hoist motor runs, is controlled as to direction by a double-pole, double-throw reversing contactor, which in turn is controlled by the cage controller. These two contactors, when they are in an out position, set the "suicide" connection of the generator ready for operation, which takes place as soon as closure of the neutralizing relay is effected.

The main power lead between the generator and the hoist motor is provided with a circuit breaker that serves to cut generator power from the motor. Mechanically interlocked with the circuit breaker is a dynamic brake switch that closes the armature circuit of the hoist motor through a resistance, whenever the circuit breaker operates and puts the hoist motor on dynamic braking. Because the hoist-motor shunt field coils are permanently excited, the motor immediately becomes a generator whenever it is driven by the weight of the cage or counterweight. As its armature leads are connected through heavy resistance, current flows through the armature, tending to stop the motor and hoist and allowing the cage to float slowly down or up the shaft. At the same time the circuit breaker operates, the solenoid brakes are applied to the hoist, so that dynamic braking would work only if the brakes should fail or when the hoist is suddenly stopped.

Whenever the field protective relay, overload relay, motor-generator overspeed governor, or emergency switch on cage control is thrown, or the alternating current power fails, the circuit breaker drops out and the hoist brakes are applied, and the hoist motor goes on to dynamic braking.

The hoisting set is regenerative whenever the motor generator is driven above synchronous speed, such as when lowering heavy loads or stopping rapidly. Power is delivered to the alternating-current power lines at these times of regeneration. One of the functions of the series exciter is to weaken the fields of the generator when it is acting as a motor during regeneration. The effect of the weakened fields is to cause the generator to run at a higher speed and make the regeneration more immediately effective. However, if the circuit breaker for the alternating-current source of power should open, no power could be delivered to the line by the alternating-current motor acting as a generator, and nothing would act to retard the speed of the motor-generator set.

Speed of the set might increase until it reached dangerous proportions. To guard against this, an overspeed governor is mounted on one end of the shaft of the motor-generator set. This opens the control circuit of the circuit breaker already mentioned, at a certain speed of the motor-generator set, putting the hoist motor on dynamic braking and setting the solenoid brakes, thus opening the circuit between the armatures of the generator and hoist motor and preventing regeneration. When this takes place, the motor generator would come to a stop, and all exciting and control power would be lost, and the hoist would be held by the springs of the solenoid brakes only; but should these fail to hold the hoist, a certain amount of residual magnetism in the fields of the hoist motor would still remain, which might make more or less effective dynamic braking.

The solenoid brakes consist of two electro-magnets working against four coil springs that serve to hold four brake shoes against the brake drums. When the magnets are energized the brakes are off, and the brakes set on any failure of power. The brake-operating contactors are controlled by a relay coil in series with the generator fields. Whenever the generator is in operation, the brakes are out. When the generator field is killed and the source of power for the hoist motor is cut off, the brakes are applied.

To keep the brakes from being applied too soon when the hoist controller is thrown off, the brake relay is provided with two coils, one in series with the generator field and one connected across the generator armature. The coil across the generator armature serves to keep the brakes from being applied until the voltage on the generator dies down. At present the brakes are applied when the hoisting speed is 60 ft. per minute and the work of the brakes is little more than holding. Regeneration and dynamic braking provide the means for slowing down the hoist.

The solenoid brake contactor is provided with three contacts. Two close the circuit through the solenoid coils and cause the brake to release, and the other contact serves to short-circuit the solenoid coils and closes only when the other two are open. When power is applied to the solenoid brake coils, full potential is at first applied and the brakes release. As the brakes require a smaller amount of power to hold them in a released position, each is provided with an automatic switch that opens as the brake operates. Two of these switches serve to cut resistance in the circuit feeding the brakes, and prevent heating of the solenoid coils. The other two serve to put a resistance across the terminals of the solenoid brake coils when the operating current is cut off the coils. When the exciting current is cut off, a direct-current magnet and electromotive force is developed in the coil itself, from the braking down of the magnetic flux, and this electromotive force developed tends to keep the magnet excited. The two switches put a resistance across the magnet coils when the power is cut off the coils, and the energy developed in the coils themselves then flows through this resistance and back through the coils, tending to keep them excited and the brakes off. As this energy is slowly dissipated through the resistance, the brakes gradually close. With a high resistance across the brake coils, the slower will the energy be dissipated and the slower will the brakes be applied. With less resistance the energy will be rapidly dissipated and the brakes, consequently, will be more quickly closed.

This elevator has a capacity of 40 men on its single deck. Since the installation was made, a 6-in. flat cable has been attached, one end to the bottom of the counterweight, the other end to the bottom of the cage, to equalize the load at all points in the shaft. This cable passes under the partition between the counterweight and cage compartments at the bottom of the shaft. No sheave wheel is used.

Handling of men and materials by means of elevators is limited by the depth of the shaft. Three installations of elevator-type cages have been described, in use at shafts of 1,000 ft. or less that are now and have been operating far more safely and economically than ordinary systems requiring hoistmen as well as cagers. No doubt, in the future, with improvements in conductor cables, especially as to tensile strength, the depth of a shaft in which these systems can be operated safely and economically will be greatly increased. In connection with the safe handling of men in shafts the induction system of signaling as developed by L. D. Stewart, of Oglebay, Norton & Company, Ironwood, Mich., is well worth considering. A description of this system was published in *Engineering and Mining Journal*, issue of May 25, 1931.

Determining Results Graphically in One-Product Concentration

Bela Low

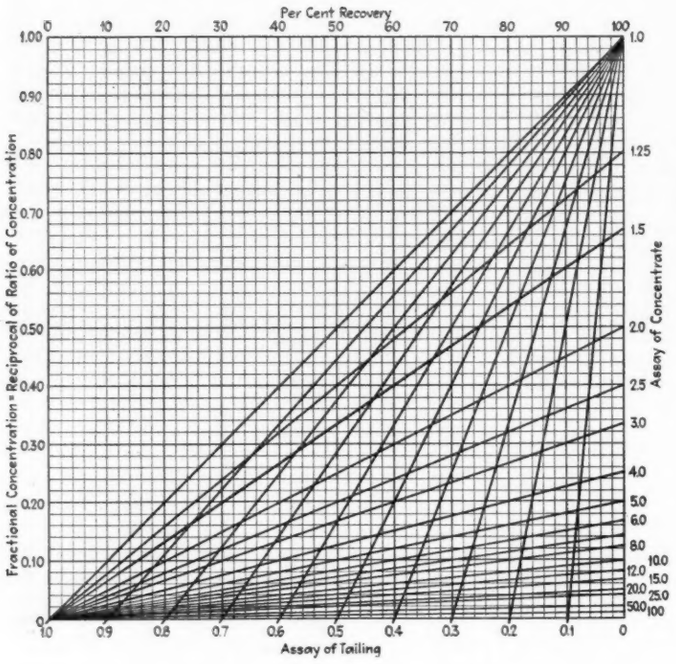


Fig. 1—Chart for graphical determination of results in one-product concentration

THE accompanying chart for one-product concentration permits the reading of recovery and fractional concentration when the assays of feed, concentrate, and tailing are known; or vice versa, the reading of assays of concentrate and tailing, if the assay of feed, recovery, and fractional concentration are known (fractional concentration equals the reciprocal of the ratio of concentration).

The chart is based on a feed assaying 1 per cent. Two examples will illustrate its use. See Fig. 1.

1. Feed assay 3 per cent, recovery 80 per cent, fractional concentration 0.20. Intersection of 80 per cent recovery ordinate and 0.20 fractional concentration abscissa is on 4 per cent concentrate and on 0.25 per cent tailing lines. Multiplying these values by feed assay gives as answer a concentrate assay of 12 per cent, and a tailing assay of 0.75 per cent.

2. Assay feed 2 per cent, concentrate 6 per cent, tailing 1 per cent. Reducing to 1 per cent feed gives concentrate 3 per cent and tailing 0.5 per cent. Intersection of 3 per cent concentrate and 0.5 per cent tailing lines shows recovery 60 per cent and fractional concentration 0.20 as the answer.

Construction of the chart is simple. After laying out the coordinates, representing recovery and fractional concentration, as shown, the lines representing assay of concentrate are constructed by letting them radiate from zero and cut the 100 per cent recovery ordinate at its intersection with the fractional concentration abscissa whose reciprocal equals the respective concentrate assay.

For instance, the 4 per cent concentrate line will cut the 100 per cent recovery ordinate at the latter's intersection with the 0.25 fractional concentration abscissa, the 20 per cent concentrate line will cut the 100 per cent recovery ordinate at the latter's intersection with the 0.05 fractional concentration abscissa, and so forth.

The lines representing assay of tailing radiate, as shown, from 1 and cut the 0 abscissa axis at its intersection with the recovery ordinate whose complement of 100 will be 100 times the respective tailing assay.

For instance, the 0.3 per cent tailing line will cut the 0 abscissa axis at the latter's intersection with the 70 per cent recovery ordinate, and so on. Thus, if the tailing lines represent equal differences in tailing assays, they will cut the 0 abscissa axis, and all abscissas, at equal intervals.

Certain simple relations which sometimes are lost sight of, and which account for the simplicity of its construction, are visualized by the chart.

The assay of a concentrate is equal to the quotient of recovery over fractional concentration multiplied by assay of feed over 100. In a 1 per cent feed, this is 1/100 of the quotient of recovery over fractional concentration. Hence the method of constructing concentrate lines.

The assay of a tailing is equal to the quotient of loss—that is, 100 minus recovery, over what I will call fractional elimination: namely, 1 minus fractional concentration, multiplied by assay of feed over 100. In a 1 per cent feed, this is 1/100 of the quotient of loss over fractional elimination. Hence the method of constructing tailing lines.

From the foregoing the conclusion is evident that with a given feed, at a given fractional concentration, the assay of tailing is proportionate to the loss and the assay of concentrate is proportionate to the recovery.

The chart also shows that with a given assay of feed, an assay of concentrate and an assay of tailing correspond to a definite recovery and fractional concentration, and vice versa. The intersection of a concentrate and a tailing line coincides with only one intersection of recovery and fractional concentration line.

The sector of the chart below the 100 per cent concentrate line has no practical meaning.

For a practical use of the chart, it will be advisable to draw a section on a larger scale, covering a desired range, so as to permit sufficient accuracy in reading. Fig. 2 shows such an enlarged section, which would be suitable for a mill in which recovery varies from 85 to 95 per cent and fractional concentration from 0.15 to 0.25. It can be easily constructed as follows:

First, the coordinates representing recovery and fractional concentration are laid out, as shown. To draw a concentrate line the determination of two points will obviously be sufficient. To

draw, for example, the 4.5 per cent concentrate line, proceed as follows: As, with a 1 per cent feed, concentrate assay equals recovery divided by 100 times fractional concentration, it follows that recovery equals 100 times concentrate assay times fractional concentration. Therefore, the 4.5 per cent concentrate line will cut the 0.19 fractional concentration abscissa at the latter's intersection with the 85.5 per cent recovery ordinate ($100 \times 4.5 \times 0.19 = 85.5$), and the same 4.5 per cent concentrate line will cut the 0.21 fractional concentration abscissa at the latter's intersection with the 94.5 per cent recovery ordinate ($100 \times 4.5 \times 0.21 = 94.5$). The other concentrate lines are laid out in the same manner.

In a similar way, two points for each tailing line can be established as follows: As, with a 1 per cent feed, tailing assay equals 100 minus recovery divided by 100 times (1 — fractional concentration), it follows that recovery equals 100 minus 100 times (1 — fractional concentration) times tailing assay. Therefore, the 0.10 per cent tailing line, for example, will cut the 0.25 fractional concentration abscissa at the latter's intersection with the 92.5 per cent recovery ordinate ($100 - 100 \times [1 - 0.25] \times 0.10 = 92.5$) and the same 0.10 per cent tailing line will cut the 0.15 fractional concentration abscissa at the latter's intersection with the 91.5 per cent recovery ordinate ($100 - 100 \times [1 - 0.15] \times 0.10 = 91.5$). Further, as recovery — 100 = loss = 100 x (1 — fractional concentration) times tailing assay, it follows that for each 0.01 per cent difference in tailing assay, the difference in loss and also in recovery, in case of 0.25 fractional concentration, is 0.75 per cent, ($100 \times [1 - 0.25] \times 0.01 = 0.75$), and in case of 0.15 fractional concentration, the difference is 0.85 per cent ($100 \times [1 - 0.15] \times 0.01 = 0.85$). Thus, after having established the 0.10 per cent tailing line, two points on the other tailing lines, each varying 0.01 per cent in assay, can be determined in the simplest way by scaling off 0.75 on the 0.25 fractional concentration abscissa and 0.85 on the 0.15 fractional concentration abscissa.

Two examples will serve to illustrate the use of the sectional chart:

1. Feed assay 4.6 per cent, recovery 88.4 per cent, fractional concentration 0.17. Intersection of 88.4 per cent recovery ordinate and 0.17 fractional concentration abscissa is on 5.2 per cent concentrate line and very close to 0.14 per cent tailing line. Multiplying these values by feed assay gives as answer: concentrate assay 23.92 per cent and tailing assay 0.64 per cent.

2. Assay feed 4.4 per cent, concentrate 21.15 per cent, tailing 0.35 per cent. Reducing to 1 per cent feed gives concentrate 4.8 per cent and tailing 0.08 per cent. The intersection of the 4.8 per cent concentrate and 0.08 per cent tailing lines shows graphical determination of recovery to be 93.6 per cent and fractional concentration, 0.195.

If still greater accuracy be desired than can be obtained from this sectional chart, the chart could be drawn to still larger scale with additional intermediary lines.

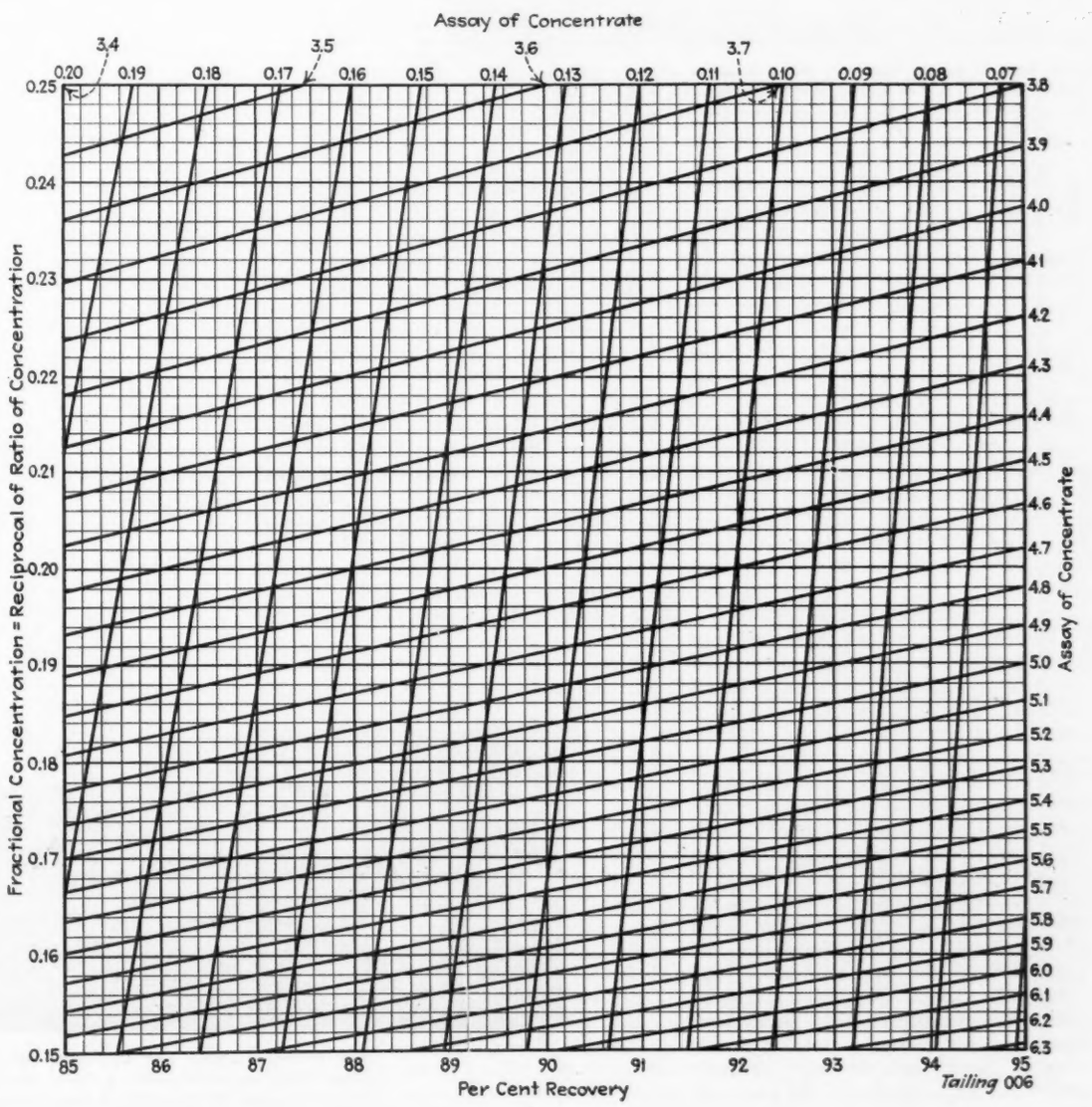


Fig. 2 — Sector of chart shown in Fig. 1, drawn on larger scale

Crushed Stone and Concrete Sand From Mine Waste and Mill Tailing

A. H. Hubbell

Associate Editor

Tailings reclaiming plant at Scrub Oaks mine. Clamshell crane in act of dropping its load through tunnel roof on to conveyor. Note portal of conveyor tunnel at right.

UTILIZATION of waste products is in general an interesting source of profits, whatever the circumstances. Crushed rock and sand are products of mining and milling operations so commonly wasted that the failure to utilize them is almost a characteristic of this work. Avoidance of such waste, though hardly rare, is sufficiently uncommon, even today, to constitute news when noted. Much of this waste is unavoidable. Without a market within shipping distance, mill tailings and mine rock, however suitable for various purposes, must necessarily be wasted. Many examples exist, however, that indicate the manner in which enterprise on the part of the management might disclose a market.

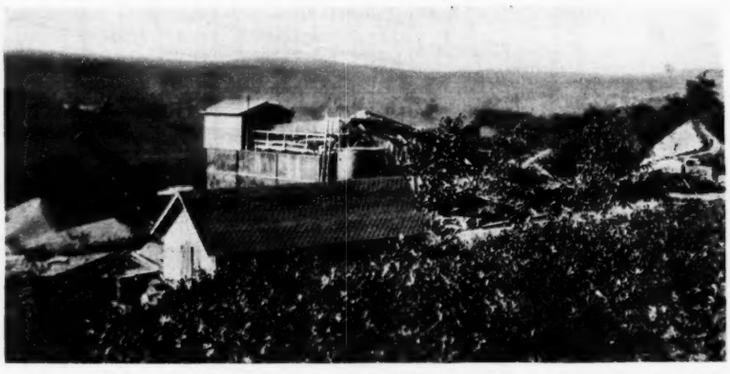
Though most mines are far from communities requiring sand and crushed stone in large quantities, sand is scarce in many districts, some of them well settled, and must be brought in from a distance, as in certain parts of eastern Pennsylvania. The operator's problem is to find an outlet, a task that differs from persuading a smelter to take one's ore and concentrate. Solution of this problem in the profitable disposal of sand may call for a slight change in the flow sheet, or for subsequent treatment of the tailing to yield a product that will pass trade or consumer's specifications.

Operators of some of the magnetite iron mines of northern New Jersey have succeeded in finding a market for a varying percentage of their tailings, which consist in general of the gneissoid granite constituting the gangue and country rock. This rock, on being crushed, tends to break into rough cubes rather than to slivers, as would a tight, homogeneous rock, such as a trap, and yeilds a suitable building sand. Crushed, it has the appearance of a natural sand, save that the grains are sharper and gray white in color. One of the companies, the Alan Wood Mining Company, a subsidiary of the steel company of the same name at Conshohocken, Pa., has developed a relatively extensive business at the Scrub Oaks[1] mine, at Dover, N. J., which property it works under lease from the Replogle Steel Company. Capt. R. E. Crockett is superintendent of the mining company's operations, and his courtesy permits me to present the following brief account of this phase of the company's work as inspected on a recent visit.

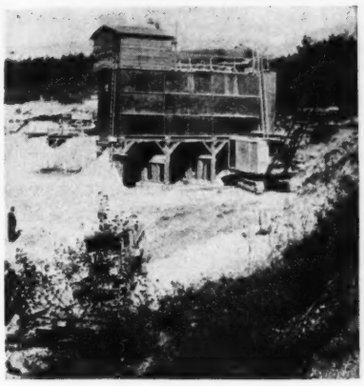
At the Scrub Oaks, where iron mining is temporarily suspended, the ore tonnage normally is approximately 30,000 per month. The ore is lean, running about 31 per cent iron and high in silica, the ore minerals being magnetite and the non-magnetic martite, the latter constituting about one-fifth of the total iron oxide. The ore occurs without appreciable contact between it and the gneiss, grading off into the latter, the silica content rising rapidly until the mineralized rock becomes uncommercial.

To concentrate this ore the Alan Wood company has equipped what is practically a new mill, incidentally scrapping most of the old equipment on the property. It is not the purpose of this article to describe the mill flowsheet, save to make clear the manner of producing and handling the sands and crushed stone. The treatment consists, in short, of dry crushing and screening to minus 8 mesh, followed by wet magnetic separation. Middlings from tables and the belt-type magnetic separators used are crushed from 8 mesh to minus 20 mesh in one pass through a 5x10-ft.

[1]This property, as then worked by the Replogle Steel Company, I described at length in *E. & M. J.* of Oct. 2, 1920.



Mine-waste crushing and screening plant at Scrub Oaks mine. Note conveyor leading from crusher on ground at right to trommel on top of steel bins.



Another view of mine-waste crushing and screening plant

rod mill, which has a peripheral discharge to avoid sliming. This is the extent of the crushing practiced.

After magnetic separation, the pulp is classified into three sizes, 8 to minus 20 mesh, 20 to minus 60 mesh, and 60 to minus 200 mesh. Tabling of the three products follows, the first and second each yielding a concentrate, middling, and tailing; and the third a concentrate and a tailing. The table tailings are final and go to a drag dewaterer, the overflow of which is controlled so that the drag discharges the desired proportion of fine material. By thus controlling the drag overflow, as well as the crushing in the rod mill, the grading of the sand in the intermediate sizes can be modified. Overflow from the drag goes to a 60-ft. Dorr continuous thickener to recover the water. The thickened product is sent to waste. Altogether about 10 per cent of the sand produced is wasted. The drag product is merchantable sand, said to be an excellent concrete sand, which passes the New Jersey State Specifications as to sizing, strength, and freedom from organic material. Table I gives a screen nalysis of the sand. The State Specifications are given in Table II.

To reclaim the sand from storage for loading into railroad cars or trucks, a concrete tunnel, housing an 18-in. belt conveyor, runs horizontally beneath the storage pile, rising for a short distance at the end, so that the conveyor may discharge into a truck or freight car. The conveyor discharges at the railroad at a point 18 ft. above the track. Holes are provided in the tunnel roof at intervals of 20 ft. Into the mill holes that develop above these in the overlying sand a crane, with a 1½-yd. clamshell, drops its load on to the moving belt through the hoppers in the roof of the tunnel, as shown in an accompanying photographic reproduction, thus permitting the selection of coarser or finer sand as desired, where segregation in the pile has occurred, and also the recovery of those sections of the pile which otherwise could not be reached by the conveyor alone.

The specifications provide also for a colorimetric test, with sodium hydroxide, for organic material; also for strength tests performed on test specimens of concrete made with the sand.

Table I—Screen Analysis, Scrub Oaks Concrete Sand (Approximate)

Size	Per Cent
— ¼ in. + 10 mesh	14
— 10 + 30 mesh	45
— 30 + 50 mesh	25
— 50 + 200 mesh	15
— 200 mesh	1
	100

Table II—New Jersey State Specifications for Concrete Sand

Passing	Retained on	Required Minimum, Per Cent	Required Maximum, Per Cent
¼ in.	10 mesh	0	20
10 mesh	30 mesh	30	60
30 mesh	50 mesh	20	40
50 mesh	200 mesh	12	25
200 mesh	.....	0	5
Maximum elutriation allowed			4%

Collar of main shaft, Scrub Oaks mine; rock pocket is shown on the left

Results must equal or exceed those obtained in the same test on similar specimens made of standard Ottawa sand.

Scrub Oaks sand is sharp and gritty and of a light gray-white color. Essentially, it is a concrete sand, making a concrete that resembles a gray-white stone. Blocks made of it look like stone blocks, pleasing to some architects by reason of their superiority in appearance to the usual ones of tawny color, made of bank sand. Because of its unusual color, however, it requires intensive selling at the outset. Its freedom from iron ore avoids the objection that otherwise might be raised by builders because of the tendency of iron-ore particles to settle out or segregate. There is no tendency whatever for the particles of iron ore still remaining in the sand to rust, as they are already completely oxidized. In this connection, a manufacturer of power-plant feed-water equipment has found magnetite ore sands less soluble than silica sands when used in his filters. Moreover, because of its sharp particles and freedom from dust, the concrete sand is being used for resurfacing asphalt roads and for stone-coating concrete shingles. For the latter purpose it has found acceptance on account of the readiness with which it takes tinting owing to its light color.

In five months of operation, the Scrub Oaks mill made 80,000 tons of this sand, all of which has been sold. Shipments from this lot to date total 25,000 tons. They are made approximately half by rail and half by truck, the latter up to a radius of 30 miles. The sales territory thus far developed by the company includes the northern half of New Jersey and eastern Pennsylvania as far as Scranton.

Competition is keen in the Alan Wood company's territory, as first-class sands are plentiful. No sales opportunities are overlooked. Jobs are watched and successful bidders followed up. Prospective customers also include dealers in building materials, and manufacturers, small or large, of concrete blocks, brick, and pipe along the railroad and highways. Freight charges customarily run from 60 to 90c. per ton.

At Scrub Oaks, a limited business is done in crushed stone, derived from the waste rock produced in the course of underground development. This rock, a close-grained gneissoid granite, is essentially similar in composition to the mill tailing, as might be expected. Five sizes of stone are produced—namely, 2½ in. average, 1½ in., ¾ in., ⅜ in., and so-called screenings.

Preparation of the mine rock for market is effected at a small crushing and screening plant near the shaft. The rock is hoisted in a 3-ton skip in the four-compartment shaft and dumped into a small bin in the headframe, whence it is transferred in a 5-ton truck to the crusher a few hundred feet away. This crusher, a 12x24-in. jaw-type Buchanan, is practically in the open, as is the rest of the crushed-stone unit, and is set to produce a maximum size of 2½ in. It discharges to an inclined belt which in turn delivers to a trommel,

Capt. R. E. Crockett, superintendent of Alan Wood Mining Company

36 in. in diameter and 40 ft. long, mounted above a set of bins, as illustrated. The trommel has five sections, making five products: screenings, $\frac{3}{8}$ in., $\frac{3}{4}$ in., $1\frac{1}{2}$ in., and $2\frac{1}{2}$ in. Oversize is stored in the last compartment and returned to the crusher by truck when there is no demand for coarse road-base material. The rectangular steel bin beneath the trommel, shown in an illustration, has six compartments, each of 60-ton capacity, to take these sizes. The circular bin at the head of the trommel receives the spill from the conveyor, being located at the transfer point.

What one mining company has done to utilize something that would otherwise be wasted is shown in the foregoing description. Perhaps in its location close to a market, some may consider it favored. But it nevertheless has to fight for this market, and a knowledge of the conditions likely to attend such work should be an aid to anyone planning to engage in similar activity elsewhere in the country. A necessary preliminary is to find the market. That done, competition is almost sure to follow.

Of the other mines in the district, the Mount Hope and the Richard are each producing a crushed stone, which is thrown off in the course of milling by successive crushing and cobbing. At the Oxford mine, a stone product consisting of minus $\frac{1}{4}$-in. screenings is sold for road surfacing and similar purposes. The Ringwood Company, at Ringwood Manor, N. J., also produce a concrete sand and a rock screening for road surfacing.

■ ■ ■

Borehole Estimation

C. E. Temperley

IN DETERMINING indicated ore from borehole results, the area involved is usually divided into triangles, with a borehole at each corner, and the average grade of each triangle is calculated from the borehole assay values. The method of weighting each borehole is by areas of influence, which assumes that a borehole commands the ground halfway to the next borehole. It therefore consists in dividing up each triangle by lines bisecting, and at right angles to, the sides.

The weight to be assigned to any one borehole of three boreholes forming a triangle is the ratio of the area inclosed by the sides of the triangle adjacent to the borehole and the bisecting lines to the total area of the triangle. Provided the three angles of the triangle are known, this ratio can be determined mathematically, without the necessity of drawing the dividing lines or measuring the areas. Three formulas are applicable:

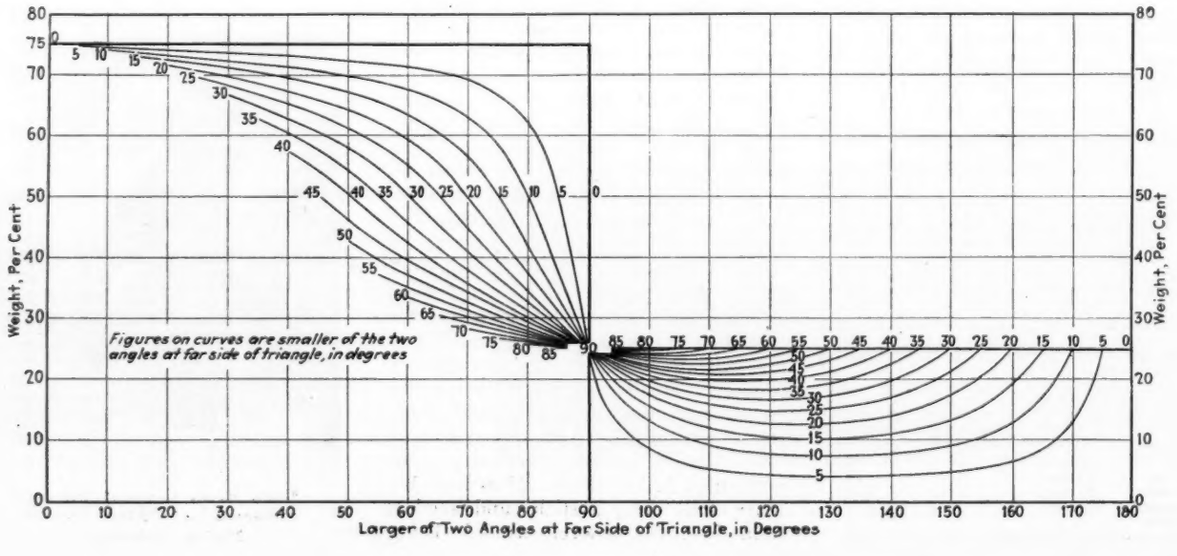
1. When one angle, A, of the triangle is greater than 90 deg., the weight of the borehole at that angle, in terms of the other two angles, B and C, is: $\frac{3}{4} - \frac{1}{4}$ tan$B$ tan$C$.

2. When no angle of the triangle is greater than 90 deg., the weight of the borehole at any angle, A, in terms of the other two angles, B and C, is: $\frac{1}{4} + \frac{1}{4}$ cot$B$ and cot$C$.

3. When one angle, A, of the triangle is greater than 90 deg., the weight of the borehole at any other angle, B, is: $\frac{1}{4} + \frac{1}{4}tanB$ cot$A$.

Formula No. 1 applies to weights above 50 per cent; formula No. 2 to weights ranging from 25 to 50 per cent; and formula No. 3 to weights below 25 per cent.

A graphical representation of these three formulas is shown in the accompanying chart, which may be employed to determine the weight of a borehole directly instead of mathematically. For instance, to find the weight of any borehole, measure the two angles at the far side of the triangle; enter the graph vertically from the bottom scale at the point representing the value of the larger of the two angles; continue upward until the curve corresponding to the value of the smaller of the two angles is reached; then move horizontally to the nearest side of the chart, where the weight of the borehole is read in per cent on the vertical scale.


Weight, Per Cent
Figures on curves are smaller of the two angles at far side of triangle, in degrees
Larger of Two Angles at Far Side of Triangle, in Degrees

Hydraulic Classification Raises Phosphate Washery Efficiency

R. G. O'Meara

THE land-pebble district of Florida, which in 1928 supplied 96.7 per cent of the phosphate production of that State and 82 per cent of the domestic requirements of the United States, is centered in Polk and Hillsboro counties, about 30 miles east of Tampa. In this area the deposits are unconsolidated sediments occurring as beds of phosphate matrix overlain by a mantle of barren sands and clays. The matrix consists of a mixture of sand, clay, and phosphate rock, in which the coarsest sand is much finer than the coarsest phosphate; that is, the sand is segregrated in the fine material.

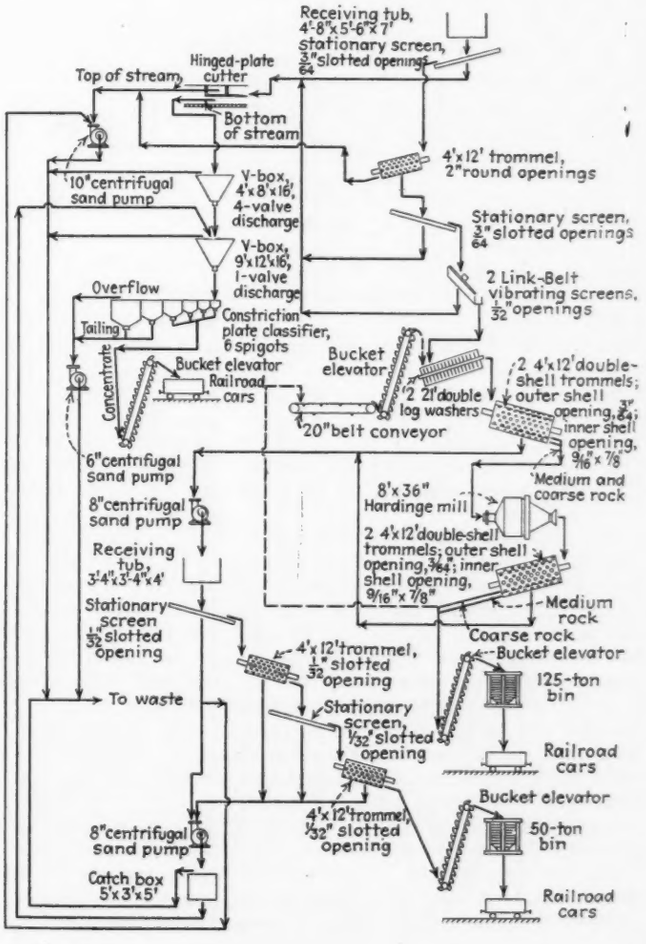
Before the introduction of the classifiers the concentration consisted of log washing, and screening at about 20 mesh, which was usually the finest size that could be taken to maintain commercial grade, 66 per cent B.P.L. (bone phosphate of lime) or more. When classifiers were introduced some of the fines that had escaped at the head of the washery and some of the minus-20-mesh material isolated during the washing and formerly lost supplied the feed.

In the early part of 1930 some of the companies in the district cooperated with the U. S. Bureau of Mines, University of Alabama, and Missouri School of Mines and Metallurgy in conducting a series of tests on hydraulic classification and tabling. Results indicated that marketable concentrate could be obtained with a recovery of 25 to 45 per cent of the phosphate formerly lost. As a result two companies have introduced hydraulic classification to treat the current tailing, and one of them has substituted classifiers for the 20-mesh screens, which had been unsatisfactory. Because the phosphate grains and quartz grains have nearly the same specific gravity, the use of concentrating tables by the customary methods is not applicable.

The practice and results obtained at three washeries, designated as Nos. 1, 2, and 3, are presented here. At washery No. 1 the average feed is 200 tons per hour in a pulp of 15 per cent solids. The recovery of washed rock is about 45 tons per hour, and the remainder, 155 tons per hour, passes to overflow tanks, from which 35 to 40 tons per hour is drawn through spigots to the classifier. The classifier circuit and other details are shown in the accompanying flowsheet. A six-spigot hydraulic classifier of the constriction-plate type is used. It is 13 ft. long and increases in width from 16 in. at the feed end to 32 in. at the tailing end. The height of the dividers between the cells is 36 in., and the overflow weir, side and end, is 54 in. The openings in the constriction plate are $\frac{1}{4}$ in. in diameter and are placed on the corners of 2-in. squares. Spigots are $1\frac{1}{4}$ in. in diameter and discharge intermittently by a mechanical device. Hydraulic water is 430 g.p.m.

Two products are obtained from the classifier: concentrate and tailing. Depending on the variation in tonnage and grade of feed, the concentrate is obtained from either the first two, three, or four spigots. The remaining spigots and the overflow make tailing. Of the 35 to 40 tons per hour fed to the classifier, about 6 tons per hour is recovered as a marketable product.

Washery No. 2 receives about the same amount of feed as washery No. 1. Two classifiers are used: One of them treats the product that was formerly tailing, and the other is interchangeable with screens. When the amount of clay is excessive, the feed to the screens is turned to the classifier. Normally the washery feed contains a great amount of clay, which, at times, increases to such an extent that screening is inadequate, because the concentrate contains a large percentage of flaky clay. Though ordi-



Flowsheet of a washery in the land-pebble phosphate district of Florida

Abstract of "Added Recovery by Hydraulic Sizing of Fine Material in the Land Pebble District of Florida," by R. G. O'Meara, Report of Investigations No. 3139, U. S. Bureau of Mines.

Average Results of Five Classifiers in Three Washeries

Size	Weight, Per Cent — Washery No. 1 Feed	Washery No. 1 Concentrate	Washery No. 1 Tailing	Washery No. 2 Feed	Washery No. 2 Concentrate	Washery No. 2 Tailing	Washery No. 3 Feed	Washery No. 3 Concentrate	Washery No. 3 Tailing
Plus 8 mesh	.....	.....	.....	.....	.....	.....	1.9	2.8	.....
Plus 10 minus 8 mesh	0.5	1.3	.....	.....	.....	.....	2.4	5.1	.....
Plus 14 minus 10 mesh	4.7	11.6	.....	3.0	11.8	.....	14.8	31.6	0.9
Plus 20 minus 14 mesh	9.8	26.3	.....	6.5	26.5	2.4	21.0	43.4	5.6
Plus 29 minus 20 mesh	11.1	27.9	4.4	9.7	32.5	4.7	15.3	14.8	15.6
Plus 35 minus 29 mesh	13.7	26.2	9.7	14.0	23.0	12.5	14.4	2.3	25.7
Plus 48 minus 35 mesh	15.2	6.7	31.2	21.3	6.2	26.6	17.4	.....	33.6
Plus 65 minus 48 mesh	15.0	.....	31.3	45.5	.....	53.8	11.3	.....	16.8
Plus 100 minus 65 mesh	13.8	.....	17.4	.....	.....	.....	1.5	.....	1.8
Minus 100 mesh	16.2	.....	6.0	.....	.....	.....	.....	.....	.....
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Weight, per cent	100.0	17.0	83.0	100.0	17.2	82.8	100.0	42.7	57.3
Assay, per cent B.P.L.	29.57	63.38	22.65	38.55	60.18	34.06	40.43	65.00	21.98
Assay, per cent insol.	62.06	22.07	70.25	49.55	22.59	55.07	44.72	11.50	69.06
Distribution of B.P.L.	100.0	36.4	63.6	100.0	26.8	73.2	100.0	68.6	31.4
Distribution of insol.	100.0	6.0	94.0	100.0	7.9	92.1	100.0	11.0	89.0

narily the product is commercial, an excess of flaky clay makes the classifier more satisfactory than screens. By the use of the classifier, a product can be made that is not only higher in grade than the screen oversize but also higher in grade than the regular washery coarse rock. The two classifiers treat about 60 tons, and when both are in operation they recover about 15 tons of concentrate per hour. Both are of the constriction plate type.

At washery No. 3 the feed is 200 tons of solids per hour in a pulp of 14 per cent density. The recovery of washed rock is 50 tons per hour, and the remainder is treated in desliming devices, from which the heavier and coarser portion is drawn to classifiers. In this plant two hydraulic classifiers of the constriction-plate type have been substituted for fine screens. The cells are 10 in. square. The height of the dividers between the cells is 12 in., and the overflow weir is reduced to 3 in. above the top of the dividers. Diameter of the spigots ranges from $\frac{5}{16}$ to $\frac{7}{16}$ in. The discharge is continuous, the tonnage depending on the size of the spigots. Hydraulic water is 275 g.p.m. About 8 tons of concentrate per hour is recovered by the classifiers. The grade of concentrate is governed by the number of spigots taken, and this, in turn, by market demands.

A compilation of results representative of the operation of the five classifiers in the three washeries is presented in the accompanying table. As near as can be determined, they recover 29 tons of concentrate per hour. However, some of this was recovered before the flowsheets were remodeled to accommodate the classifiers. Additional recovery as a result of the use of the classifiers is about 14 tons per hour. The added cost is so small that the operation is regarded as successful, even though the additional recovery is limited to the coarsest phosphate formerly wasted. The hindered settling ratio of sand and phosphate is so small that it is of little value. Losses in the fines are still high, and the use of classification should be regarded as transitory, awaiting the perfection of a more applicable process.

In summary, the washery practice of the land-pebble phosphate district of Florida may be said to consist essentionally of log washing and screening on about 20 mesh. The oversize is concentrate and the undersize tailing. Phosphate losses have been incidental to the use of screens too coarse for the fine phosphate. As early as 1927 hydraulic classification was considered as a means of re-treating the tailings. In 1930, two companies cooperated in conducting tests on classification and tabling of phosphatic sands. Results showed that table concentration could not be recommended, but that the sizing obtained by a hydraulic classifier would make possible a recovery of the coarsest part of the phosphate formerly sent to waste.

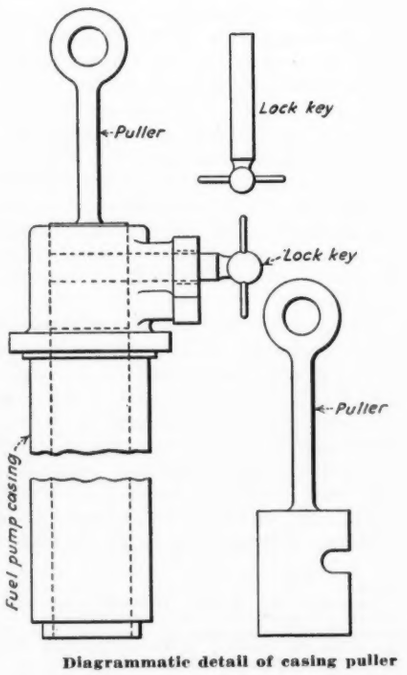
Following this work, one of the companies adopted hydraulic classification and obtained a recovery of 25 to 45 per cent of the material fed to the classifier. During a three-month operation the classifier added 15 per cent to the production. Another washery was equipped in a similar manner. The washery feed contained an unusually large amount of clay, and screening was unsatisfactory because of the residual flakes of clay in the washed product. After substitution of a classifier for some of the screens, higher-grade concentrate was obtained through the rejection of much of this flaky clay. Now five classifiers are installed in three washeries, and hydraulic classification has increased the yearly production about 81,000 tons.

■ ■ ■

A Simple and Economical Fuel Pump Casing Puller

REMOVAL of fuel-pump casings from cylinder heads of diesel engines is a difficult task, requiring skill and patience, as the restricted dimensions prevent the use of a chain or cable. Usually, the casings are removed by hand with the aid of small bars, or in some other provisional manner—all slow and unsafe methods. To expedite and simplify this procedure, Joe Carothers, mine master mechanic at Old Dominion, Globe, Ariz., developed the simple and inexpensive casing puller illustrated. It can be made in sizes to fit any casing, and consists of a steel eyebolt attached to a cylindrical piston-shaped body equipped with a milled-in slot for the lock key.

The piston part of the puller is placed in the bore of the casing and locked with the traversing key, resting in one of the fuel-supply connections, as shown in the accompanying sketch. With the cable hook suspended from the crane fastened to the eye of the puller bolt, each casing can be removed in a few seconds.



Diagrammatic detail of casing puller

Elsing Sublevel Shrinkage Method of Stoping

J. B. Huttl

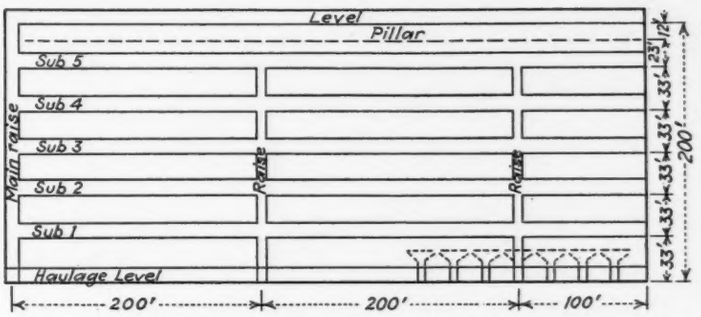


Fig. 1—Method of development for stoping by Elsing sublevel shrinkage method. A patent has been granted. Longitudinal section.

ECONOMIC CONSIDERATIONS and safety are fundamental factors that govern the selection of a mining method. Once the method has been decided upon, the consideration of safety still guides and controls decisions as to the size of the stope, pillars, and the spacing of the pillars. If the method requires timber, safety usually determines the size and amount of timber, as well as the number and spacing of safety raises, and other principles. Efforts to reduce costs often result in unsafe practices, and, conversely, an overemphasis upon safety raises costs. These two factors work in the opposite direction. Improvements in mining methods, therefore, must reduce the cost per ton of ore, or unit of metal, and at the same time increase the safety of the working place.

A new mining method, unique in conception and layout, which will meet the preceding requirements, has recently been devised by M. J. Elsing, of Tucson, Ariz. The method is called sublevel shrinkage, and a patent covering its use has been granted.

In brief, the method is a combination of shrinkage and sublevel stoping. Breaking is done by drilling and blasting radial rounds—a conventional practice used in tunnel enlargement. The method is applicable to stoping any orebody which can be worked by shrinkage or by sublevel stoping. Under certain conditions of wall-rock the method can be used in working veins where timber is now necessary.

Method of Development—The method can be applied to working a wide variety of orebodies, but to facilitate a clear description the vein is assumed to be 35 ft. wide and vertical. Fig. 1 is a longitudinal projection of the stope development required. The main haulage drift is in the center of the vein, as are all of the subdrifts above it. The block to be prepared for stoping is 500 ft. long. This block will require one main raise and two small raises. The main raise is timbered with square-sets and equipped with a small hoist for handling material and supplies. By extending it to the next level 200 ft. above, adequate ventilation is assured. The other two raises are small cribbed raises at 200-ft. intervals from the main raise. In all three raises sublevels are driven at 33-ft. intervals. These subdrifts measure 12x12 ft. in cross-section, which permits the use of scrapers for mucking the broken material directly into the chutes.

Method of Stoping—The method of stoping is shown in Fig. 2. Ore chutes are placed at 25-ft. intervals along the haulage level. Starting at the end of the block to be mined, at a point 5 to 8 ft. above the roof of the drift, these chutes are belled out and the broken ore is drawn. This will leave a small open stope. Immediately above the first of these stopes in sublevel No. 1, drill holes are fanned out, as in Stage 1 of Fig. 2. The holes are then blasted, and sufficient ore is drawn to accommodate that to be broken by the second series of rounds in progress of being drilled. Stage 2 shows conditions before blasting the second series of rounds. The condition of the stope after completion of the third series of rounds is shown in Stage 3. Next, sufficient ore is drawn from chute No. 2 to provide room for the ore to be broken by the round which has been drilled. The stope is advanced by systematic repetition of the preceding. The angle of the plane between the broken and unbroken ore is determined by the angle of repose of the broken ore.

Drilling and Blasting—Fig. 3 illustrates a plan of the drill round. A round consists of 22 holes comprising a total of 320 ft., of which the deepest hole is 19 ft. With a 5-ft. burden this round will break about 700 tons of ore. All holes are in one plane which has an inclination equal to the angle of repose of the broken ore. The ground, therefore, is broken into the stope and not into the drift.

Exact spacing of the holes, the burden upon them, and the amount of powder required depend upon the nature of the ground. Once this has been determined, drilling can proceed well in advance of blasting. In some operations sublevels will be completely drilled before blasting is done. Advantages of this procedure are (1) the routine standardization of operations, and (2) a large number of drills can be in operation in the sublevels, under closest supervision where labor is not efficient.

Where the stope is 35 ft. wide, the drifts are driven 12x12 ft. in cross-section, to permit the use of long steel needed to drill the deepest hole. Drilling is done with heavy drifting machines using steels up to 22 ft. in length. To drive smaller drifts, and then enlarge

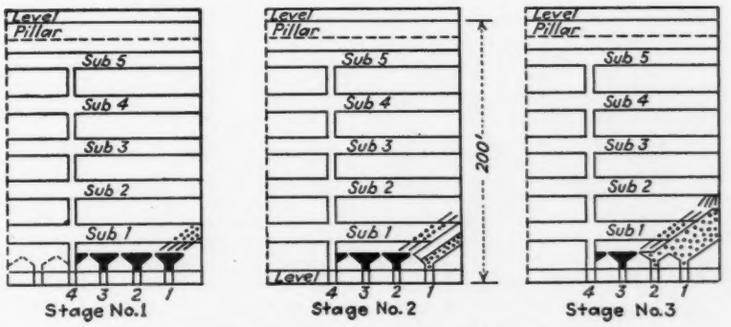


Fig. 2—Method of starting incline shrinkage stope by Elsing sublevel shrinkage method. Longitudinal section.

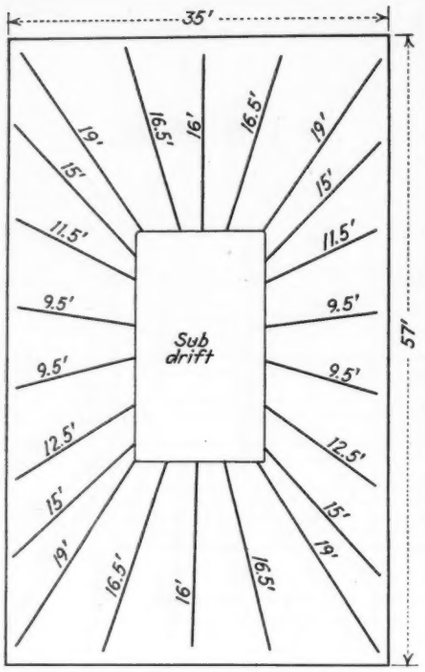


Fig. 3—Drilling round, in plane parallel to angle of repose of broken ore. Elsing sublevel shrinkage method. Twenty-two holes, totaling 320 ft., with a 5-ft. burden, yield 700 tons per round.

powder to break the ore into small fragments and reduce the amount of blockholing to a minimum. Blasting is done electrically.

Drawing Ore—The broken ore is drawn before blasting, in amounts equal to the tonnage obtained from one drill round. The void made by drawing the ore is filled immediately when blasting the next round. In this manner the stope is kept full of broken material most of the time. Serious cave-ins cannot occur, because the unbroken ore is supported by the broken ore. Men working in the sublevels are fully protected from this hazard. In good ground no actual support will be required, and slightly more ore can be drawn than is blasted. Under such conditions a small space will exist between the plane of the broken ore and the solid ore. Under certain conditions to keep a small opening will be desirable, but should the ground become

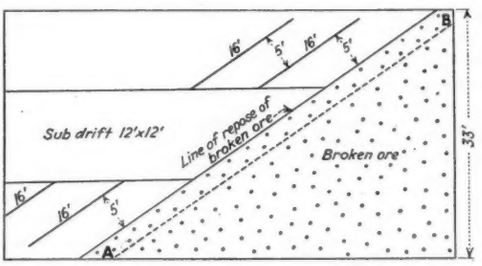


Fig. 4—Longitudinal section showing method of drilling radial long holes. Elsing sublevel shrinkage method.

from 200 to 100 ft., this tonnage can be reduced to 37,500 and 12,000 tons respectively. Disadvantages of small stopes include higher mining costs and the amount of ore left in level pillars. This can be obviated by immediate pillar recovery after mining. Obviously, the size of the stope depends largely upon the standing characteristics of the wallrock and the inclination of the hanging wall.

Pillar Recovery — Particularly noteworthy is the ease, safety and low cost of pillar recovery. Before drawing of ore is started, the level pillars, as in Fig. 5, are drilled and shot down after or while the stope below is being emptied. This section of the mine can then be allowed to cave and be abandoned.

If the pillars are not recovered until years later, sloughing and caving will dilute the recoverable ore even under the most favorable conditions of

them to facilitate the drilling of the holes, is not advisable, as the cost for hand mucking and extra drilling and powder is favorably outbalanced by better operating conditions and mechanical scraper mucking in the large-size drifts. Generally, the matter of the size of drifts depends upon the nature of the ground, width of the stope, and the vertical spacing of sublevels. Large drifts probably require temporary timber sets to support loose, slabby ground, and to provide a staging to facilitate drilling of the upper holes. The physical characteristics of the ore determine the burden on the round and the amount and strength of the powder to be used.

To prevent the breaking of large slabs, the use of rounds with less burden may be found advisable, and stronger less favorable this opening can be quickly filled to support the face of the stope. Fig. 5 shows a stope which has reached maturity. Until that time only 40 per cent of the ore broken will have been drawn. After reaching maturity, 40 per cent of the broken ore is drawn from chutes Nos. 17, 18, and 19, and 60 per cent from chutes Nos. 1, 2, 3, and 4.

Size of Stopes—The size of the stope is an important consideration. In Fig. 5 is shown a stope 500 ft. long, 35 ft. wide, and 180 ft. high. This size has numerous advantages, but it has one disadvantage—about 75,000 tons of broken ore is tied up in the stope. By leaving pillars as in Fig. 7, or by reducing the distance between the levels

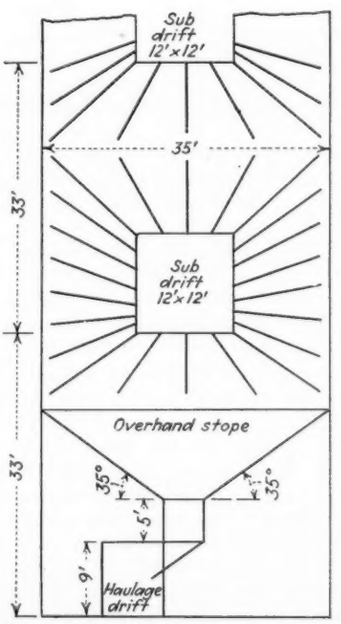


Fig. 6—Vertical cross-section, illustrating radial method of drilling (holes projected on section). Elsing sublevel shrinkage method of stoping.

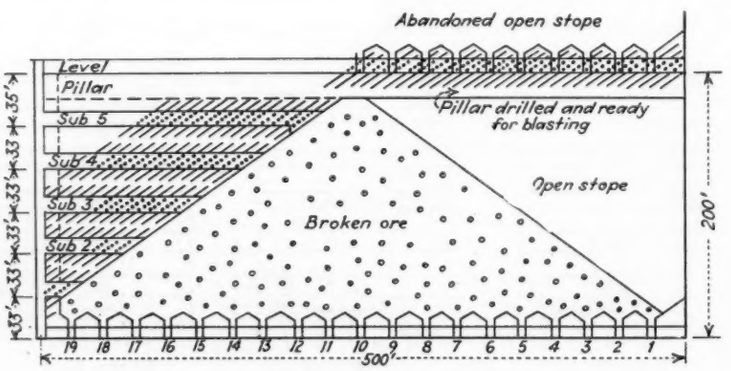


Fig. 5—Method of drawing, under Elsing sublevel shrinkage method of stoping

the wallrock. Delayed pillar recovery is always attended with added dangers, higher costs, and the possibility of complete loss because of the ground taking weight to the extent that pillar ore cannot be recovered. Should the walls

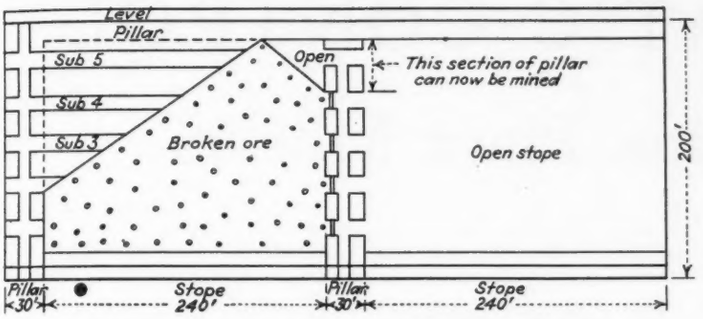


Fig. 7—Stopes and pillars. Elsing sublevel shrinkage method.

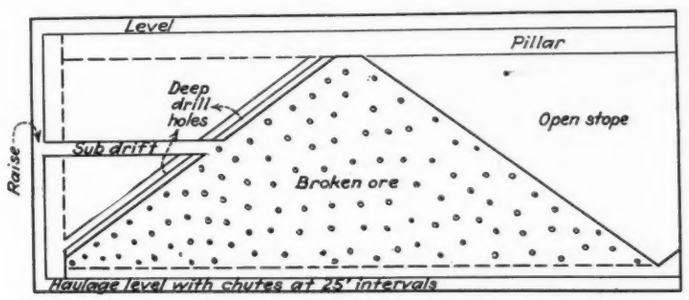


Fig. 7A—Elsing sublevel shrinkage stoping, using only one sublevel. Longitudinal section.

require support, vertical pillars as in Fig. 7 can be left wherever necessary and recovery made as soon as desirable.

Chutes vs. Grizzlies—The foregoing description of the development work is based upon the supposition that the ore will break sufficiently small to offer no difficulties when being drawn through the loading chutes. If the ore, however, is inclined to break in large massive blocks or slabs, the development layout would have to include a grizzly level. This would in no way change the principles involved. It would merely mean that the first sublevel would be placed at a somewhat higher elevation. A grizzly level would no doubt permit the placing of a greater burden upon the stope drill rounds, and effect a saving in powder. The lower primary breaking costs thus obtained would, however, be balanced by the secondary breaking at the grizzlies.

Variations—Breaking ore can be accomplished in several ways. Under certain conditions only one sublevel need be driven, from which deep holes are drilled, as shown in Fig. 7A. Drilling is done with deep-hole drilling machines employing sectional steel, or with diamond drills. Other variations of the method eliminate subdrifts, in place of which incline raises are driven parallel to the angle of repose of the broken ore, and from which drilling is done. Variations have been worked out whereby horizontal and flat-dipping beds, exceeding 20 ft. in thickness, can be exploited by this method. The method is applicable to mining large orebodies with pillars, and subsequently mining these pillars. Wide orebodies can be mined with sublevels and crosscuts or two parallel drifts. The method affords a wide application and flexibility of operations.

Costs—The cost of mining will vary according to the type of ore deposit mined and the physical characteristics of the ore. In the case of the orebody indicated in Fig. 5, in which the ore is considered medium hard, weighing 12.5 cu.ft. a ton in place, and assuming that pillar recovery is carried on immediately following stoping, the estimated costs are as given in the accompanying table.

Advantages of the Method—These are as follows:

1. Stoping and development per ton will be from 30 to 50 per cent less than by any other method which is applicable.

2. The safest working conditions are provided, as men never work in an open stope but in solid ground which is supported by broken ore.

3. Great production can be obtained from a single stope, which permits centralization of operations and a minimum amount of capital tied up in advance development work.

4. Every operation is standardized to the maximum, which makes it especially adapted to the employment of unskilled labor.

5. Pillar recovery is made safer, more complete, and with less dilution than by any other method.

Conclusion—The method described in the preceding has been patented, not with the idea of restricting its use, but rather that it be tried, improved, and used in as many localities as possible. In general, there are more opportunities of cutting costs underground than on the surface. Most operations in mills, smelters, and ore handling on the surface have reached a higher degree of perfection than those underground. The successful patenting of underground methods and devices should be a stimulus to further thought and study for the attainment of lower operating costs and safer operating conditions underground.

Estimated Cost of Mining by Elsing Sublevel Shrinkage Stoping

Block 500 ft. long, 200 ft. high, 35 ft. thick
Block contains 280,000 tons

Recoverable from stope	238,000 tons	
Recoverable from pillars	30,000 tons	
Total	268,000 tons	
Stope development		**Cost per ton (Cents)**
5 Sublevels 500 ft.; 2,500 ft. @ $12.50	$31,500	11.9
2 Small cribbed raises 180 ft.; 360 ft. @ $12.00	4,320	1.6
1 Main raise 200 ft. @ $22.00	4,400	1.6
20 Chutes @ $50.00 each	1,000	0.9
Main haulage drift 500 ft. @ $25.00	12,500	4.8
Totals	$56,220	20.8
Total stoping costs		**(Cents)**
Stoping development		20.8
Supervision		3.5
Drilling		6.0
Powder		9.0
Air, drills, steel		12.0
Drawing chutes		5.0
Miscellaneous		8.0
Cost per ton delivered to cars		65.3

AUTOMATIC CONTROL
Of Mine Plant Motors

H. W. Chadbourne

A GROWING demand for automatic control prevails among operators of mills, coal tipples, and similar plants that require a number of motors. Such control is so arranged that the motors will start one after another, in any order or sequence desired. This so-called sequence operation is desirable in any operation where the work done is progressive, as, for example, in a system of conveyors or feeders.

In addition to the advantage gained by starting the motors in the correct order, automatic control is so interlocked that, if any motor is shut down owing to failure of its electric circuits or to failure of its mechanical load to function properly, all preceding motors will automatically shut down. By preceding motors is meant those motors driving conveyors and other equipment that feed material toward the motor in question. A simple, one-line, sequence diagram which may be extended indefinitely, is shown in Fig. 1.

One of the best-known installations employing sequence control is the five-mile conveyor of the H. C. Frick Coke Company. This conveyor system consists of twenty sections, each driven by a wound-rotor induction motor. The control is so arranged that, if the start button is pushed, No. 1 motor, at the delivery end of the system, will start. When the final accelerating contactor on No. 1 motor closes, an interlock closes the control circuit of motor No. 2, causing it to start. Motor No. 2 starts motor No. 3, and so on, until motor No. 20 is up to speed. If any motor shuts down, all motors whose conveyors are delivering coal toward it will shut down automatically. That is, if motor No. 5 shuts down, motors Nos. 6 to 20, inclusive, will stop. A double-throw switch on each motor panel makes possible the operation of any motor by itself for tests.

The success of the five-mile conveyor system led to the installation of a shorter system by the Frick company. This second conveyor system is about two and a half miles long and consists of twelve sections. Each section is driven by a wound-rotor induction motor. The method of starting is the same as that employed for the five-mile system. When shutting down, however, the different conveyor sections must coast the same distance to avoid the piling up of coal by one section or another. Several of the conveyor sections, with a slope of 15 to 18 deg., are equipped with flywheels, so they will coast as far as the other sections

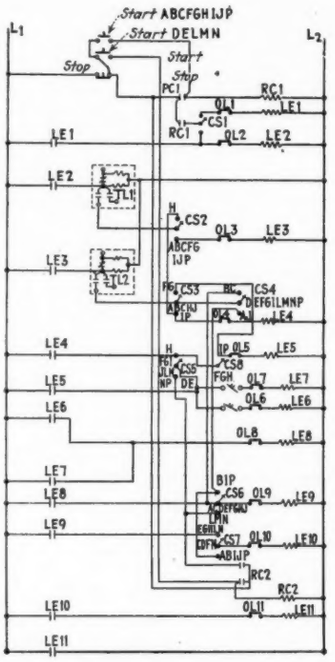


Fig. 2—Diagram of sequence-control installation employed at a coal-mining operation

when power is removed. Solenoid brakes prevent them from running backward. The brakes are kept released by direct current until the conveyor has coasted the desired distance. The period that the brake is held in the released position is determined by an adjustable definite time relay. Direct current is supplied by a small exciter set, with a flywheel that actuates it after the alternating-current power fails.

Other applications may be cited in which the total number of motors may be less and the operation more complicated. For instance, an installation at Hillman Coal & Coke Company for the operation of a coal tipple includes eleven

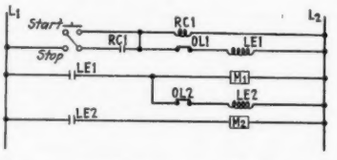


Fig. 1—Diagram of a simple, one-line sequence operation

motors and control apparatus. The tipple receives coal from two shafts and delivers it to either a railroad or river docks. The motors are of the double squirrel-cage type, placed directly on the line. Fourteen different combinations are required for starting the motors, depending on the kind of coal handled and where it is to be taken from and carried to. For example: the requirement may be "run-of-mine coal, No. 1 shaft to river." This means that the conveyors driven by motors Nos. 1, 2, 3 and 10 must start in that order, followed by motor No. 11, which drives a feeder. Or the requirement may be: "all No. 2 shaft to railroad," which means that motors Nos. 7, 6, 8 and 9 must start in sequence. In addition to the fourteen different starting combinations, several different arrangements are employed for shutting down the motors. For instance, if No. 7 or No. 6 motor shuts down, the shutdown of Nos. 5, 3, 2 and 1 is optional; or in another sequence, if Nos. 1, 2, 3 or 5 shut down, the shutdown of No. 6 or No. 7 is optional. A diagram for this equipment is shown in Fig. 2. As this is a one-line diagram, the motors are not shown; moreover they would complicate the diagram. *RC1* and *RC2* are control contactors; *LE1, LE2* line contactors; *OL1, OL2,* overload relays; *CS1, CS2,* control switches; *TL1* and *TL2* definite time relays.

This installation, in addition to the starting contactors with their interlocks for each motor, also requires a master panel, which has mounted on it six *SP-DT* selector switches and one, *SP-ST* selector switch, and a push-button station with two start buttons and one stop button. As nearly all of the motors are 10 hp. no effort is made to keep the motors from starting in rapid succession. Two larger motors, one 50 hp., are employed, however, and, wherever one of these is in sequence, a definite time relay delays its starting, until the preceding motor is up to speed. To make quick and accurate operation of the equipment possible, each of the required combinations has been assigned a letter, as *A, B, C,* and each selector switch has a nameplate above it. These nameplates are stamped with the letters of the various combinations. The operator wishing to use any combination, as *A,* simply throws the selector switches as indicated on the nameplate, and then pushes the start button.

An installation at the property of the Chateaugay Ore & Iron Company consists of the electrical equipment for

operating a crushing and separating mill. Thirty-two motors, each with its control, are employed for driving a jaw crusher, roll crushers, conveyors, feeders, blowers, generators, and separators. The main sequence includes 24 induction motors, all of the wound-rotor type. These motors always start in the same order, except that, by the use of selector switches, four of them can be left out of the sequence and operated separately. One unusual feature of this control is that the motors driving the crusher rolls start in the reverse direction—to loosen the ore in the rolls—then stop, and start in the forward direction. The control is arranged so that two or three of the accelerating contactors close in the reverse direction; then they drop out and the forward contactor closes. The dropping out of the accelerating contactors and the closing of the forward line contactor are controlled by time limit relays.

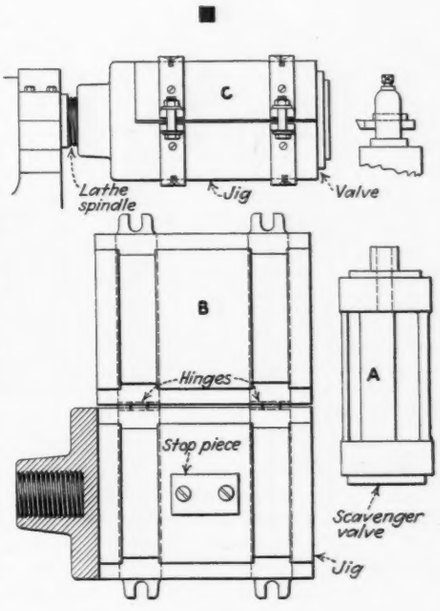
This equipment is elaborate. It has a switchboard panel and an oil circuit breaker for each motor. The master control panel, in addition to the start-stop pushbutton, has a bank of red and green lamps to indicate whether the motors are running or not. Before pushing the start button, the operator acutates a sound signal, so that anyone working near the machines is warned. At each motor is an emergency switch, all of which are connected in series. The opening of any one of these switches shuts down the entire equipment. By throwing a *SP-DT* switch on any panel, the motor can be operated independent of the system. The sequence type of control is a practical and efficient method for any operation that requires a number of motors functioning in a definite order. It saves labor and time. One particularly desirable feature is that each individual control panel is a standard unit, or includes but slight changes from the standard. This makes possible the use of reliable apparatus, built in quantities, at comparatively low cost. Addition of a master panel and the necessary interlocks is not usually expensive. As all safety devices used are circuit opening, the breaking of a control wire or failure of an interlock to close either shuts down the equipment or fails to start some of it, and thus does not tend to cause any serious trouble or breakage of equipment.

A number of different types of motors may be used in sequence operations, as any motor can be started by automatic control. For instance, an ordinary squirrel-cage or synchronous motor may be used either with a starting compensator or placed directly on the line. If both alternating- and direct-current motors are used, the control becomes more complicated, but it can be satisfactorily developed. When several motors are placed directly on the line, a small time lag will occur between motors, and several may be accelerating at the same time. This would draw a comparatively large current from the line. If this is objectionable, definite time relays can be used between the motors, so that a smaller number will be accelerating simultaneously. If wound-rotor induction motors are used, with several steps in starting, either current-limit or time-limit acceleration may be employed, and the acceleration time may be adjusted to suit the operator. In any event, a motor cannot start until the final accelerating contactor on the preceding motor is closed and the preceding motor at nearly normal speed. Owing to its having several steps during acceleration, a wound-rotor induction motor lends itself especially well to this class of service. Although synchronous motors have not been used extensively in the past for sequence operation, no objection can be made against them from the standpoint of control, and their ability to give leading current for power-factor correction favors their use.

■ ■ ■

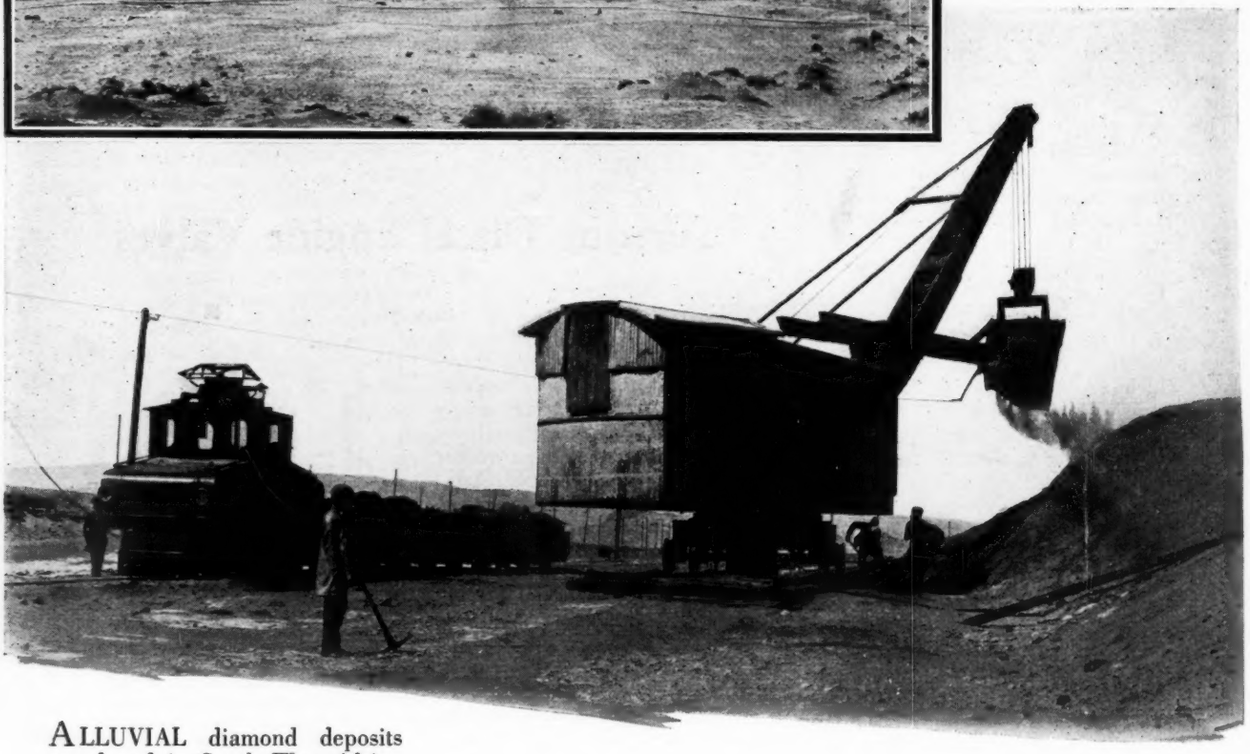
Turning Diesel Engine Valves

REMACHINING worn seats of diesel-engine scavenger valves by the conventional lathe-chuck method frequently involves waste of time and inaccurate results, necessitating costly manual adjustment. To overcome these difficulties, Joe Carothers, mine master mechanic of Old Dominion, Globe, Ariz., devised the efficient method now in use at the company's repair shops, and illustrated in the accompanying illustration. The valve casing *A* is held by the carefully machined clamp-like jig *B*, attached to the lathe spindle, as shown in Fig. *C*. This saves time in centering the casing, and insures uniform work. The jig is made of cast iron, and consists of the body proper and a lid, which are held together by two hinged clamps, of machined mild steel. Two short $\frac{5}{8}$-in. bolts and four spilt clamp ends, or ears, constitute the lock mechanism. A small screwed-on stop-piece on the jig bore keeps the inserted valve casing from turning when the cutting tool is applied. The threaded end bore of the jig body may be machined to fit any lathe spindle.



Diamond Mining in South West Africa

terial directly into cars for treatment at the washing and concentrating plant. Power is furnished by the Luderitz plant of the South West Electric Power Company, a subsidiary of the diamond company.



ALLUVIAL diamond deposits are found in South West Africa, north of the Orange River, at a distance of about 12 miles from the coast. These deposits were worked by German companies during the War, but are now nearly all held by Consolidated Diamond Mines of South West Africa. The pictures show the company's plant at Kolmanskop and the modern methods of excavation used. The diamonds occur for the most part in the upper layer of loose detritus, along the floors of north-south troughs. This layer is usually only a few inches thick, but it may be as much as 25 ft. The diamonds are concentrated with coarse material, from 1 to 10 mm. in diameter. No stripping is involved in mining; therefore, the electric shovels load the ma-

Personal Notes . . . Comment . . . Criticism

A. E. Larson is now president of Sunshine Mining, operating a silver-lead property in the Coeur d'Alene district of Idaho.

George Allen has been elected president of the Broken Hills Mining Company which is operating the Paymaster property near Lewiston, Calif.

D. D. Irwin, general manager of Roan Antelope Copper, who has been on vacation in America and England, is returning to Northern Rhodesia.

Arthur D. Storke, managing director of Roan Antelope Copper, has returned to London, after a prolonged visit to the Roan Antelope and Mufulira properties.

N. C. Rockwood, editor of *Rock Products,* has been made president of the Tradespress Publishing Company, succeeding W. D. Callender, who died recently.

J. V. N. Dorr was elected to the presidency of the American Institute of Chemical Engineers for 1932 at the annual meeting held at Atlantic City recently. Mr. Dorr's affiliation with the Institute has extended over several years, during which time he has contributed greatly to its advancement into an enviable position among professional organizations in the United States.

H. S. Kimball was recently elected vice-president and member of the board of directors of the Illinois Zinc Company. Mr. Kimball, formerly president of the American Zinc, Lead & Smelting and more recently president of the Remington Arms Company, will direct the development of Eraydo alloys, with headquarters at 52 Vanderbilt Ave., New York City.

Traffic Problems in the Mining Industry

The Editor:

So much discussion has been caused by my article in this journal entitled "How Attention to Traffic Conditions Cuts Costs," and I have received so many inquiries, that a plan has been outlined for operators who are unable to hire their own traffic managers.

Several mining engineers have asked what they are expected to do about the present trend toward reducing expense by watching traffic costs. Most of them admit that they know nothing about it. Few popular magazines do not contain advertisements by correspondence schools of home study courses in traffic. Much can be learned thus, but at least seven hours per week must be spent for a year in hard study. Many students have plunged into traffic work and made a success of it after four months' study. An engineer who can write into his reports a detailed traffic survey of the particular property on which he is operating or reporting will go far toward getting repeat business. So far as can be checked from the catalogs issued by the various colleges specializing in mining and allied courses, none offers a study of traffic management. But the mining engineer retorts, "I'll admit all you say. I have written my Alma Mater urging it to add this study to the course, but just the same I'm at a loss how to proceed. I don't want to lose out on any business or improvements, but I can't get time to study, and anyhow I'm too old to study." This type of man should obtain a directory of the nearest large city. Under "Traffic Managers" will be found from one to fifty names listed. Of course the individual must check these names with his bank, credit bureau, or whatever means he may want to use to determine integrity.

Most of these firms work on a basis that includes the following services and their prices:

1. Quotation of rates and/or routing advice for prospective shipments.
2. Advice as to important changes in rates on shippers' products.
3. Advice on proper application of tariff or rate.
4. Advice as to proper application of the classification rules, including proper packing, marking, classification.
5. Advice as to embargos, sailing of steamships, routing of trains, lists of open and prepay stations on all the railroads, airline connections.
6. Appearances before the Interstate Commerce Commission and State commissions. Only persons duly licensed can appear before the I.C.C.
7. Advice as to the duties of the carriers in regard to delays, discriminations, failure to furnish suitable equipment, fire, misdelivery, misquotation, refusal to accept goods for shipment, strikes, floods.
8. Securing passenger reservations on rail, steamer, bus, or air line. Any one of these services is usually performed at a rate of $2 per hour of actual time.

In addition, these firms audit freight bills for errors on a percentage of the amounts collected. Nearly all of these firms work on this basis: (1) Overcharge claims shall be paid 50 per cent commission; (2) regular loss and damage claims, 25 per cent commission; (3) loss and damage claims previously declined, 50 per cent commission, except when suit or formal complaint is necessary to effect payment, when the fee shall be 50 per cent after all expenses have been deducted. These firms mostly audit and collect freight bills. In one year alone, $130,000,000 was expended in settlement of freight claims, of which about 27 per cent was for overcharge.

In addition to the auditing of freight bills, the traffic managers—or traffic corporations, as they are often called—endeavor to have rates lowered whenever possible. For this service, which takes much investigation and other expensive work, they charge 50 per cent of the saving effected over two years.

In addition to the various functions named in the foregoing these firms usually take agencies for insurance companies and sell marine, truck, truck cargo, automobile, and travelers' policies.

To the mine manager interested in cutting costs, who has not the time to obtain education on this subject, the industrial traffic office offers the logical solution to his problem.

A. L. Russell.

Prescott, Ariz.

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Suggestions for Converter Operators

The Editor:

Looking back over the files in *Engineering & Mining Journal* I find much information in regard to the operation of basic copper converters, magnetite lined; some dates back fifteen years, but it is as true and of as much value today as at the time it was written.

The process of forming a magnetite lining reminds one of the pilgrimage of a certain Hindoo, who made the trip to the holy shrine by taking two backward steps for every three steps he advanced. In some instances the brick lining has been known to be damaged by burning back before the magnetite lining started to form, making the combined thickness of brick and magnetite only slightly greater than the original brick lining. This may be caused by a prolonged blowing with raw matte, possibly up to eight hours, before the magnetite starts to form on the lining.

During my stay at the Shorey smelter, in Peru, an exceptionally weak shell, showing red spots and spitting matte next to the tuyeres, had to last for an additional 24 hours, so that a full month's run might be obtained on two converters. At the time I had a short charge which I ran high. After skimming I transferred a little metal to get all of the slag, continuing blowing for about one hour on what would be the final blow. The converter was then turned down for half a ladle of 25 per cent matte, and blown for about two hours, full blast, but light. This resulted in a smooth magnetite lining, on which the regular charge was built. The converter operated the next day without giving trouble, and stood a good, hot wash-out. If this method is successful for an ailing converter, it should also be useful for a converter in good condition.

Another interesting detail in the practice was the use of the entire output of the sintering plant for converter flux. This was a siliceous material that was giving trouble in the furnaces. On one shift no

other flux was used, and the amount of sinter handled in this manner exceeded the output of the sintering plant for the same period. The converters operated satisfactorily under these conditions, producing a slag with 22 per cent silica.

An important question arises in connection with the after-blow—that is, a silica blow of from 5 to 25 minutes, according to conditions and quantities, on a charge of copper—which under normal conditions would be finished—to expel the remaining sulphur, lead, and other impurities. Why has the resulting copper silicate slag such a caustic effect on the magnetite lining if the heats are not watched closely? Here is opportunity for someone with a good knowledge of chemistry and metallurgy to find an explanation.

Among old processes that are still applicable, the Knudsen process of smelting and converting should be suitable for a small plant treating pyritic copper ore and siliceous gold and silver ores, the smelting of which would possibly be the chief object.

F. E. WING.

Tacoma, Wash.

■

California Compensation Rates Impose Heavy Surcharge

The Editor:

Again the mining industry of California faces increased cost of workmen's compensation insurance. The rate effective Jan. 1, 1932, will be $10.99, an increase of 45c. per $100 payroll. It appears as though the industry will be forced out of existence by this condition.

It is admitted that accident costs are operative costs. Also that the compensation insurance costs of California are higher than any other State except New York.

California has a higher loading expense for compensation insurance than any of the other metal-mining states; this is often referred to as overhead. In fact, in California, overhead is the highest factor entering into rate fixing, amounting to 40.6 per cent. For instance, of the three factors entering into rate fixing—namely, compensation, medical, and overhead—compensation was 44.1 per cent, overhead 53.1 per cent, and medical 2.8 per cent. Using the rate of $10.54, the following components were allowed: overhead, $4.28; compensation, $4.23; and medical, $2.03.

It is interesting to note that under overhead an allowance is made of 79c. for home-office charge, acquiring of business $1.84, payroll audit 21c., and State and Federal tax, 32c.

In Oregon, the overhead is limited to 10 per cent, the State paying 5 per cent of this amount; in Nevada 11 per cent; in Washington it was formerly 7 per cent but now there is no charge; Arizona is 11.8 per cent.

It is interesting to note that in California, employees receive only 39.3 per cent of the compensation insurance costs, whereas in Arizona they receive 74.6 per cent, in Nevada 70.2 per cent, in Oregon 74.9 per cent, and in Washington 72.6 per cent.

The premiums paid by mines in California for compensation insurance amount to $400,000 per year. Estimated payroll is about $6,000,000.

These excessive compensation insurance costs affect gold mining more than any other branch of the industry, and it is unfortunate, indeed, that this condition exists, for it discourages investments.

It should be borne in mind that excessive overhead affects all industries in this State, not being confined to mining alone. How long will industry continue to stand for this condition?

G. CHESTER BROWN.

San Francisco.

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Witherite in the Americas

The Editor:

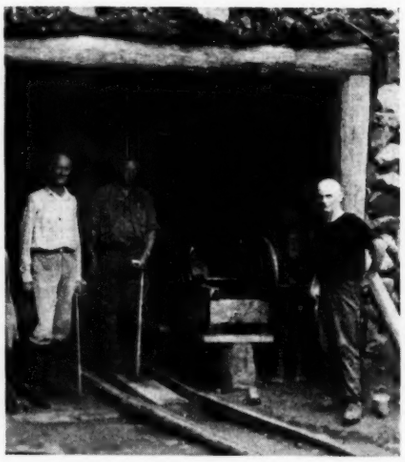
In the issue of Nov. 9, recounting the finding of a deposit of witherite in Alaska, occurs the statement: "This is the first known deposit of witherite in Alaska. . . . the other two being in Kentucky and Ontario."

Permit me to call you attention to the fact that in Mariposa County, Calif., at El Portal, is a deposit of witherite associated with barite, from which, beginning in 1915, a considerable tonnage has been shipped. Apparently it is the only deposit in the United States from which commercial shipments of witherite have been made. You will find this opinion verified in "Mineral Resources of the United States, 1915," Part II, p. 170; also the following reports of the State Mineralogist of California—XXII, 1920, p. 102; XXIV, 1928, p. 145; XXVI, 1930, p. 51, 52; also p. 57. The last-noted page records an occurrence of witherite in Shasta County, Calif., but from which there has been no commercial production. The annual statistical bulletins of the State Division of Mines, showing mineral production since 1915 (Bulletin No. 71, p. 66), have recorded data relative to these shipments.

Relative to witherite in Kentucky: In Series VI, Vol. 27, 1925, entitled "Mineralogy of Kentucky," on page 84, we find the following statement: "Witherite, the carbonate of barium, appears to be wanting in Kentucky." Has there been a discovery of witherite in Kentucky since the above-noted report was written?

WALTER W. BRADLEY,
State Mineralogist

San Francisco, Calif.



A recent photograph, taken in New Guinea, of Tom Harris, Carl Lindberg, and contractor Delancey, on the power site of Bulolo Gold Dredging

Credit to M. Dor-Delattre

The Editor:

It was with much interest, in view of the dearth of published data on zinc smelting and particularly on reduction furnaces, that I read in your August issue the article by Messrs. Seiffert, Koch, and Matthies entitled "Berzelius Zinc Smelters." I was the more interested because for over ten years I have had the good fortune to be in charge of construction, installation, operation, and control of many furnaces of the same type as those used at Duisburg.

I hope, therefore, I may be permitted to fill in what I consider an important omission from the article wherein is described the furnace and the arrangements for ventilation. Reference might be made to French patents Nos. 358,150, of Sept. 29, 1905, and 391,513, of June 20, 1908, and credit is due to the eminent Belgian specialist, Emile Dor Delattre. After a whole life devoted to developing a practical and successful furnace which has also ameliorated the conditions under which the operator must work, Mr. Dor has the right, in spite of his extreme modesty, which is well known to all his engineering colleagues, to their homage of admiration and recognition. I feel sure that the authors of the article will be glad to have me supplement their data with this mention of one who deserves so much credit.

ANDRÉ SANSON,
Engineer of Arts and Manufactures.

Auby (Nord), France.

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Obituary

R. H. Bradford, for more than twenty years professor of metallurgy at the University of Utah, died in Salt Lake City on Dec. 9, after a long illness.

William M. Rex, of Denver, Colo., general manager of the Ingleside Limestone Company's quarry near Sunrise, Wyo., was instantly killed on Nov. 10, when struck by a gravity tram at the quarry. He is survived by a widow and one daughter, residents of Denver.

Frederick Samuel Jordan, for thirty years in the nickel industry, died at his home in New York recently. He was 62 years old and had been connected for many years with the Canadian Copper Company, and when that firm merged with the International Nickel Company in 1902, he remained as sales executive.

Carl Lewis, metallurgist and one of the witnesses for Consolidated Coppermines in its suit against Nevada Consolidated Copper Company, died at Carson City, Nev., on Dec. 14, following a week's illness. He was educated in Iowa. He served in the navy during the War. He then entered the employ of North American Corporation, of San Francisco, as metallurgist, and also carried on research work in Chile and other countries. For two years he had been connected with Consolidated Coppermines company.

New Publications

PROSPECTING FOR GOLD. *By Ion L. Idriess. Second edition. Sydney, Australia: Angus & Robertson; 5s. ($1.25).*

PROSPECTING for gold is active the world over, and interest in gold mining attracts considerable attention. Why, after years of more or less indifference? Because, though prices for the common and rarer metals have fallen to low levels, and more commodities can be purchased by the pound sterling or by a dollar than in a long time, the price of gold remains the same and its recovery is more profitable. In Australia, a premium is being paid on gold, but depending on its production compared with recent years. From our Western States, Canada, Alaska, South America, Africa, Asia, New Zealand, and Australia we are told of this renewed search for gold. It is needed; it is doubtful whether too much affects any country. Canada recently published a bulletin on prospecting in the Dominion; Goodwin has a book for each of four Canadian provinces; the second edition of an American handbook was recently published and is being well received; and now we have Idriess's effort for Australians.

The centenary number of the Sydney (New South Wales) *Morning Herald*, April 18, 1931, reviews gold in Australia, whose discovery was the result of keen observation. Edward Hammond Hargraves went from Australia to California in 1849 and, noting the similarity of the occurrences there to those in the foothills of the Blue Mountains of New South Wales, he hurried back, and in February, 1851, found gold. He was truly a prospector. Since then, Australia has contributed $3,100,000,000 in gold to the world. This year (1931) there has been renewed activity in mining at Kalgoorlie, Wiluna, and elsewhere in Western Australia, and recently a beautiful nugget worth $27,000 was uncovered south of that place, at Larkinville, and more recently a pocket of $2,900 was dug out north of it, at Goongarrie. "W. A.," as the State is termed, will yield much more gold.

As to this book, in the two editions of 2,000 copies each, it is for Australians, yet it should be suggestive anywhere. Simplicity of language and the use of the prospector's terms characterize the treatment. It is the result of twenty years of prospecting. At the outset, the inexperienced prospector is warned not to go into untried country, but to ask the State Mines Department for advice; the new country is for the experienced man. Yet he admits that "new chums" or "tenderfeet" have stumbled on many rich deposits. Not many tools and only a small amount of equipment are required for gold, but some cash and a "cheerful heart" are essential. Dry or wet watercourses should be sampled and panned. Dishing or panning is described; so is cradling and dryblowing —all well done. The instruction in building of a cradle, sluice box, dryblower, flume, ditch, and dam are given in a way that anyone could make them. And their use is covered in similar style. Some advice: "If there are specks of gold in a sluice box, pick them out; they are safe there, but safer in a tin." "Don't work long and strenuously and then be careless in cleaning up." The basket-work riffle used in Queensland and New Guinea is shown and described.

Idriess has a chapter on how to make water work and advises men to study the vagaries of water. The secrets of alluvial gold and ground are revealed—dry and wet season work. There are 40 pages on hydraulicking, in which a plant costing $100 to $150 is explained, including giants, guns, fall, foot pressure, pounds' pressure, head, intake, pipe lines and their vagaries. Dryblowing is next covered. Some men swear by it, but it loses fine gold unless a man is expert with the machine, and the author feels sure that there are abandoned dry-blown areas which would pay to wash. Prospecting for reefs receives attention, including floaters, knapping (sampling) outcrops, pestle and mortar, indicators, patches, and panning. "Of course, if you strike a golden reef your troubles of a lifetime are over," he concludes.

A glossary and index conclude a plain-spoken and practical work for prospectors. M. W. VON BERNEWITZ.

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A CANADIAN GEOLOGIST. *By W. A. Loudon. Toronto, Ont., Canada: MacMillan Company of Canada; $2.50.*

JOSEPH BURR TYRRELL is the subject of this biography, which comes from the pen of an old friend who knew him as a boy. The story, simply told, presents, in the main, an impressive picture of the tasks of a Dominion Survey Geologist assigned to explore the wilds of the Canadian North, when the country was less well known than now. Tyrrell entered the Survey in 1881 and stayed in it until 1898, when he resigned to go out into the world, as he said, to see if he were worth more than $1,800 a year. Thrills lie between the lines of the prosaic recital of his journeys by foot and by water, first, as the cub member of a party exploring the Crow's Nest Pass, Kicking Horse Pass, and the Kootenays; then on trips through northern Manitoba, Saskatchewan, and the stretches west of Hudson Bay. His two trips across the Barren Lands, one of them nearly disastrous, directed public attention to that great North country, says his biographer. Then he married, quit the Survey after an assignment in the Klondike, and returned to the scene of the gold excitement to try his fortunes on his own. His varied luck, his slow but certain progress to success in consulting work, make up the latter part of the story—the least interesting from the reader's viewpoint, and also from the biographer's, apparently, for Mr. Loudon sketches it but briefly. A few sketch maps of Tyrrell's journeyings would have helped the book materially.

A. H. HUBBELL.

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COPPER DEPOSITS OF THE WATERSHED OF CONGO AND ZAMBESI RIVERS. *By P. Kovaloff. Johannesburg, South Africa: The Technical Press, Ltd.; 2s. 6d.*

This pamphlet presents principally a concise summary of the more recent geologic information that is available concerning the copper deposits of the Belgian Congo and Northern Rhodesia. According to the author, much of the material in the publication was collected in the course of personal visits to the deposits at the time of the Fifteenth International Geological Congress, which was held in South Africa last summer. Besides frequent references that give it bibliographical value, the pamphlet is well illustrated with numerous photographs and drawings.

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SPECTRUM ANALYSIS IN MINERALOGY. *By A. A. Fitch. London: Adam Hilger, Ltd., 24 Rochester Place, Camden Road, N.W.1; 1s. 11d., post free.*

THE convincing results obtained and the various methods used for this increasingly popular means of analysis are adequately treated in a brief and interesting manner. The directions are definite and clear, with frank statements of actual results, of limitations when present, and of possibilities of still further development. A long list of references is given for more detailed study should that be desired, and 24 pages are used for a list of analyses of minerals from all parts of the world. This extensive list of actual work accomplished with widely varying types of minerals is perhaps more instructive and convinc-

ing than many pages of claims for the value of spectrum analysis.

Modern instruments are illustrated and directions given for their use. Details are given for making a qualitative analysis. Other subjects are "Quantitative Analysis," "Mineral Concentrates," "Rocks," "Meteorites," "Mineral Waters," "X-ray," and "Absorption Spectra." The subjects are extensive and the information presented is the essential gleaned from the present available knowledge on the subject.

The author has been engaged in spectrum analysis of minerals and metals for one of the leading manufacturers of instruments in this field, so he is in a position to judge what is most useful and instructive. From his study of the scattered material available and his own work he has selected the essentials for the benefit of the reader who is interested in fact and results rather than theory and experiment. Seven pages of references are also given for those desiring more details.

One gathers from this article that qualitative analysis is very successful, providing the sample is not too complex. Mention is made of recent work and some soon to be published on mineral concentrates which will no doubt contain information on methods for complex samples. It is suggested that spectrum analysis is best applied when used as an accessory to chemical methods. Unfortunately, no mention is made of the time required, yet this is an important factor. Certain successes in quantitative analysis are cited which give one a tantalizing glimpse of what may be possible in the near future. In the meantime, to keep well informed, and perhaps even assist in some further development work in this new field, is desirable. The booklet summarizes the available knowledge to date and should be read by all who desire to keep up with the times.

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WERKSTOFFE PHYSIKALISCHE EIGENSCHAFTEN UND KORROSION. VOL. I, ALLGEMEINE TEIL. *Metallische Werkstoffe, Pp. 976. Vol. II, Nichtmetallische Werkstoffe. Pp. 391. By Erlich Rabold. Leipzig: Verlag Otto Spamer. M. 135.*

Increasing attention to the problem of corrosion makes this book a timely one. A discussion of the theories involved is followed by a complete review of the materials used for apparatus, machinery, and equipment. Primarily of interest to the chemical engineer and the metallurgist, the book does, however, contain information of value to practically every branch of engineering. The book is well indexed and contains numerous illustrations, graphs, and tables, among which must be mentioned a list of all corrosive substances, arranged alphabetically for reference work. Bibliographies, with over 10,000 references, going back to 1897, add greatly to the value of the work.

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A DESCRIPTIVE PETROGRAPHY OF THE IGNEOUS ROCKS. *By Albert Johannsen. Pp. 267; illus. Chicago: University of Chicago Press; $4.50.*

FOLLOWING a short and very general introductory chapter, Professor Johannsen discusses briefly the "constituents" (the reviewer prefers the term "components") of igneous rocks. Thirteen pages are devoted to a description of rock glass, crystallites, spherulites and allied "constituents," and in the remaining ten pages are described the structural features of some of the rock-forming minerals, such as deformed crystals, zonal growth, secondary enlargement, and the like. The illustrations pertaining to this chapter are excellent, but the subject matter could be expanded with decided advantage to the book.

The third chapter, in which textures and structures of igneous rocks are described, is open to the same criticism. In the opinion of the reviewer it is too brief. Most of the features described, and illustrated, are dependent upon the *arrangement* of the components constituting the rock, which is productive of different patterns. This *arrangement* of components I prefer to call *structure*, reserving the term "texture" for the various *sizes* of the component grains. The use of the two terms is, however, a matter of personal preference among petrographers.

The rest of the book, exclusive of the two appendices and the tables in the back, which constitute a third of the whole volume, is concerned with a description of classifications and systems, qualitative, "chemical," quantitative and quantitative modal, devised by numerous petrographers from the days of Rosenbusch and Zirkel to the present time.

This volume should prove a convenient reference text for students of petrography. Professor Johannsen has assembled necessary information, heretofore scattered; he has furnished the student with an excellent up-to-date glossary of petrographic terms and a large number of good illustrations of structures and textures common to igneous rocks. He has, moreover, introduced the student to some of the men who have brought petrography to its present high plane by including reproductions of photographs of them—a very excellent feature. There is also a well-selected bibliography—always an aid to the student. The reviewer awaits the appearance of the second volume of this work with interest.

R. J. COLONY.

STANDARDS AND SPECIFICATIONS FOR NON-METALLIC MINERALS AND THEIR PRODUCTS. *National Bureau of Standards. For sale by Superintendent of Documents, Government Printing Office, Washington; $2.75.*

This is a publication of 680 pages, wherein are presented the fruits of standardization activities in the field of non-metallic minerals of over 70 organizations qualified to speak for industry or the federal government as a whole, and nationally so recognized. It includes all nationally recognized standards, specifications, and simplifications within its scope, in one form or other; also, methods of testing incidental to the formation of commodity specifications; and, in addition, illustrations, tables, a list of references, and a list specifications for the products covered. of organizations issuing standards and specifications for the products covered.

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ZINC, SECOND EDITION (1920-1929). *One of the Imperial Institute's Series on the Mineral Industry of the British Empire and Foreign Countries. H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2. Pp. 193; 3s. net.*

This bulletin is on a par with others of the series that have already made their appearance. A vast amount of information on zinc is included. After a preliminary chapter on the metallurgy, uses, and world production of zinc, the metal is discussed country by country, those of the British Empire receiving consideration first. The bulletin concludes with a bibliography of recent technical literature.

Received

THE AUTOBIOGRAPHY OF AN ENGINEER—*William LeRoy Emmet. By W. LeR. Emmet. Pp. 213; illus. New York: Fort Orange Press, Albany. $2.*

OVERLAND WITH KIT CARSON. *The record of Lieut. G. D. Brewster, U. S. Army, who, with Carson, first reported the discovery of gold at Sutter's Creek. Edited by Stallo Vinton. Pp. 301; illus. New York: Coward-McCann; $4.*

GEOMAGNETIC SURVEY OF THE BAUXITE REGION IN CENTRAL ARKANSAS. *By Noel H. Stearn. Arkansas Geological Survey, Little Rock. Pp. 16, with several maps.*

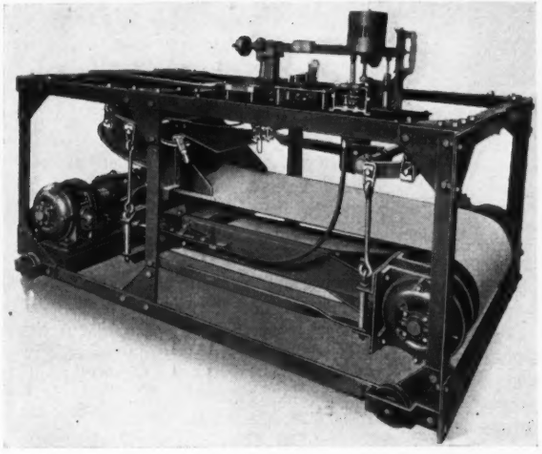
LABORATORY CONCENTRATION OF MISSOURI IRON ORES OF IRON MOUNTAIN AND PILOT KNOB. *By F. D. De Vaney and S. R. B. Cooke, Bureau of Mines and School of Mines, Rolla, Mo.*

POTASH BIBLIOGRAPHY IN 1929. (ANNOTATED). *By J. F. T. Berliner, Bureau of Mines, Washington, D. C. Pp. 578. For sale by the Superintendent of Documents, Washington. Price, 90c.*

INDUSTRIAL PROGRESS

Conveyor Scale Uses Photo-electric Cell in Totalizing Weight

Other Recent Equipment



This conveyor scale embodies the most recent application of the photo-electric cell for service in the mining industry

The photo-electric or light-sensitive cell is now being employed as a means for totalizing the weight of materials transported by the Telepoise feeder and conveyor scales, made by John Chatillon & Sons, of New York. The photo-electric unit used is the so-called Radiovisor made by the Burgess Battery Company. This is employed in conjunction with a simple but ingenious invention of the scale manufacturer, to convert electric impulses into pounds, barrels, short, long, or metric tons. The advantages of this modern improvement are obvious and numerous; it eliminates parts subject to wear, adjustments, and, finally, replacements. It is positive and instantaneous in operation. Weigh beam and levers are not employed as prime movers for any device; they are free to indicate accurately the weight on the scale, which is electrically transmitted to a register, indicator, or recorder, or a combination of any two or all three of these instruments.

For Controlling Floodlights

The General Electric Company has introduced a new outdoor-type photo-electric controller which responds readily to the increase and decrease in daylight intensity and is designed to control floodlight installations and any other outdoor lighting equipment. The new controller, known as the Novalux, consists of a weatherproof case inclosing a light sensitive photo-electric "eye," a vacuum tube, contactors and time-delay relays. Any change in intensity of the average daylight around the photo-electric tube is picked up by the tube, which controls the grid of the amplifying vacuum tube. The photo-electric tube thus indirectly actuates the main contactor. Thermal time-delay relays are provided to prevent instantaneous operation whenever a cloud passes over the sun, a flash of lightning takes place, or a person walks in front of the unit. Operation is positive in that the main contactor will not flutter at the critical light intensity.

Adoption of Photo-electric Control Increasing

Increasing application of photo-electric cells for controlling various operations commonly involved in mining or plant work makes of interest the introduction of any new device of this sort. The Burgess Battery Company, 202 East 44th St., New York City, has recently developed ready-to-use light-relay and light-source units of simple, strong construction. These units are designed around the Burgess light-sensitive cell, developed in England and recently made available in this country. These units may be had in both a.-c. and d.-c. models The light source units may be had in similar models, each one containing a 12-volt, 21-candlepower bulb with a focusing optical system to concentrate the light beam on the light-sensitive surface of the light-relay unit.

New Floodlight

For floodlighting areas where lighting requirements do not necessitate larger standard floodlighting units, General Electric has introduced a unit for general use, which employs a 200-watt incandescent lamp. It weighs approximately 6 lb., measures less than 15 in. in height with its supporting stand, and is 12½ in. deep from center of lens to tip of lamp holder. The diameter of the lens, which is of special heat-resisting glass, is 10 in. The new unit is composed of a sheet-aluminum combination casing and reflector, pressed together.

One-Piece Underframes for Mine Cars

The trend at present toward the adoption of one-piece cast-steel underframes for mine cars by the coal industry is a development that operators in other divisions of the mining industry might note with profit. The move is being sponsored by the General Steel Castings Corporation, Eddystone, Pa., and Granite City, Ill., which company is the maker of the so-called "Commonwealth" cast-steel one-piece underframe with integral floor plate and pedestals. So equipped, the capacity of a mine car can be increased, it is said, without increasing the size of the car, or the height of car can be reduced 15 to 25 per cent without reducing the capacity. This type of construction is said to give lower maintenance cost, because many rivets, bolts, and detail parts are eliminated and strength and durability secured. Capacity in general is greater, because the underframe is shaped to secure the maximum volume. Haulage costs are lower because of correct wheel alignment. The life of the car is increased because cast steel resists corrosion, and, by the type of construction used, acid-collecting seams and joints are avoided. Rigidity is afforded because the unit construction permits the use of integral attaching brackets for the superstructure and auxiliaries, a feature that favors rotary dump operation. This construction is said to be safe and economical because there are no loose foundation parts to fail and cause derailment or other accidents.

Increases Stripping Capacity

Output of stripping shovels is said to have been greatly increased by the application of the balanced hoist feature developed in the last few years by Bucyrus-Erie, and only recently announced after more than a year's experience in the field with several

Balanced hoisting is a feature of this shovel, increasing its speed and capacity

installations. This is said to be one of the few definitely new features in shovel design introduced in the last five years. The new hoist greatly increases the output of the shovel by permitting an increase in dipper size and in shovel operating speed. Essentially, its parts consist of a movable counterweight with the necessary guides and tackle, so arranged that as the dipper goes up through the bank in digging, the movable counterweight travels downward in its guides, counterbalancing practically all of the dipper weight and increasing the force available for digging. The dipper is returned to the pit for the next cycle, and the counterweight is raised in its guides, so that once more it is ready to counterbalance the dipper on its way up through the bank. Thus, during the hoisting cycle practically all power of the hoist motors is spent in actual digging, because the dipper is counterbalanced by the descending counterweight.

Advantages thus gained are: Increased digging power with respect to both speed and digging force, without the use of larger electrical equipment; faster acceleration of the dipper in both digging and returning to the pit; more accurate handling of the dipper, particularly when loading into cars; less heating of hoist motors and generators, and lower average current consumption and longer life; reduction of peak loads and consequent reduction in the current figure registered by the demand meter. This type of counterbalanced hoist makes it possible to use much larger dippers without increasing the size of the electrical equipment and without an appreciable increase in the total weight of the machine beyond the greater weight of the dipper and its contents. No increase in the total amount of counterweight is necessary, inasmuch as a weight equal to the movable counterweight would be found on an ordinary stripper as a stationary counterweight.

Scraper Bucket Used With Dragline

A recent development in excavating practice centers around the use of a crane or revolving dragline to operate a Sauerman "Crescent" scraper bucket for stripping overburden and moving materials from pits and rivers. The combination of one of these scrapers and a boom machine is said to be an efficient means of handling sand, gravel, crushed stone, and ores any distance up to 300 ft. This combination may be substituted for a tower excavator to advantage when the yardage to be handled is not large enough to justify investment in the latter type of machine.

Rigging up any type or make of boom machine for operating one of these buckets is relatively easy. The line speeds of cranes and draglines are slower than those of regular drag scraper machines, and rope capacities of the drums are limited; nevertheless, most cranes and draglines can be converted to drag-scraper operation, it is said, without mechanical alterations other than the placing of suitable lagging on the drums. Occasionally, provision of an outboard support or guy cable for the boom is desirable when the digging is particularly hard.

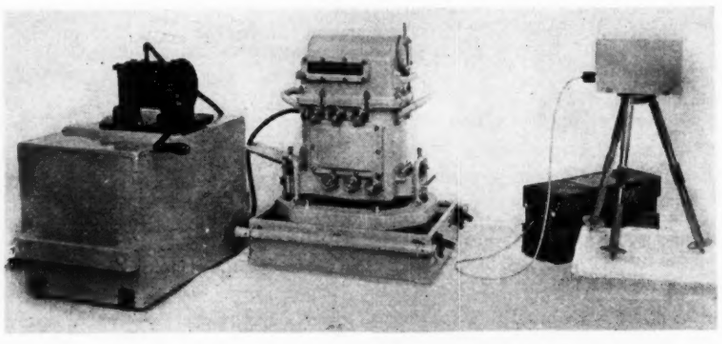
The regular drag cable is replaced with a longer cable which attaches to the front chains of the scraper bucket. The regular hoist cable also is replaced with a longer cable, which leads over the sheave at the end of the boom and out to a movable tail anchorage. This latter cable serves as an inclined trackline for the carrier and bucket.

No swinging, raising, or lowering of the boom is involved; instead, the boom generally is held at its maximum elevation during the operation. The track line is slackened off while the bucket is digging and bringing in a load, but when the bucket arrives at the dumping point, the operator pulls this cable taut by a few revolutions of one drum, thus raising the bucket into the air. As the bucket is bottomless, it drops its load automatically when lifted. Then the load cable is allowed to unwind from the other drum, and the carrier, impelled by gravity, carries the empty bucket back down the inclined track cable to the point of excavation.

In equipping a boom machine with a scraper bucket, a bucket of a capacity substantially larger than that of the standard dragline bucket for which the machine is rated can usually be employed.

For Geophysical Work

A new Askania three-pendulum apparatus for geophysical work has recently been introduced. It is said to embody certain improvements over previous designs. It may be seen in an accompanying illustration. Advantages are said to be compactness and portability. The accuracy of the company's ordinary three-pendulum apparatus has been greatly increased by using a new form of pendulum, the maximum error in determining the force of gravity amounting to $\pm 2 \times 10^{-4}$ cgs. for an observation period of two hours. Another important feature also is the economy with which the equipment can be operated through the use of a pendulum outfit at a base or reference point, the base instrument, with the proper radio equipment, being used to send out



Improved three-pendulum apparatus facilitates, certain geophysical work

time signals for the field pendulum at any desired time, and for any necessary duration. Thus the field crew will not be dependent upon the International Time Signals sent out every 24 hours, which in a way will materially speed up observation work. In accessible country trained crews with a field instrument should make about three stations per day.

So far most of the pendulum work in the United States has been of a scientific nature and has been done at a number of stations in different parts of the country by the U. S. Coast and Geodetic Survey for the determination of the force of gravity. With the improvement of pendulum equipment and the greater economy in field surveys, interest in pendulum work for commercial purposes is gaining ground. Several oil companies have recently undertaken gravity surveys with modern pendulum apparatus in order to obtain information about large regional subsurface structures. Also, as a supplement to torsion-balance work, interest in pendulum observations has increased considerably.

For Abrasive Screening

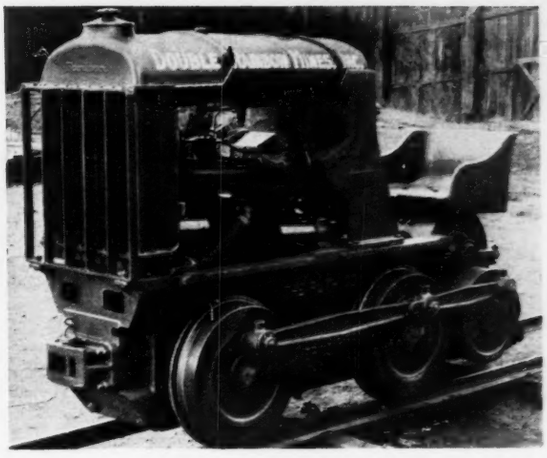
For screening applications where abrasion is unusually severe, John A. Roebling's Sons' Company, Trenton, N. J., have developed an abrasive-resisting steel wire screening. They have given it the name of Jersey Abraso EE spring steel, and it is said to be especially adapted for use in vibrating, rotary, shaking, and gravity screens. The alloy steel used is made by a special process and is being supplied in practically all specifications from 6¼-in. openings down to 18 mesh.

Vibrator Screen-mounting Stabilized

A unique stabilizer mounting, recently built into the Stephens-Adamson vibrator screen to prevent bucking or rocking when sudden loads are received, and to hold the screen at a certain angle, is one of the latest improvements on vibrating screens. The stabilizer consists of two pairs of short arms, jointed like an elbow and held parallel by a rigid cross bar. One end of each arm pivots on the flywheel housing, which is fastened to the sub-frame; the other end of each arm is shackled to the screen body.

Two New Gasoline Locomotives

For use in mines where ventilation is good, the Ruth Company, Denver, Colo., has introduced a gasoline mine locomotive designed with minimum clearances. This is an 18-in. gage locomotive which is only 31½ in. wide, or 13½ in. narrower than the industrial type previously put out by the company. It is, moreover, 4 ft. 4 in. high, and has a 10 gal. radiator. The over-all length is 7 ft. 2 in., compared with 9 ft. 2 in. in the industrial type, so that the new model will negotiate curves more readily. Side-rod drives are used to make possible the narrow width and the very low center of gravity and at the same time eliminate such disagreeable features of chain drives as stretch, wear, and adjustment. Gears and pinions are of heat-treated alloy steel. All gears are carried on alloy-steel shafts and Timken bearings running in oil and totally inclosed in a cast-steel case, which also contains the reversing mechanism. The latter gives five speeds in either direction. The locomotive is powered with a Ford Model AA motor. This type of locomotive may be had in sizes of 2, 2½, 3, 3½, 4, and 5 tons, all 18-in. gage.



This gasoline locomotive has been designed with minimum clearances for mine service

Another gasoline-driven locomotive recently introduced and powered the same as the foregoing is the new BFA Model of the Brookville Locomotive Company, Brookville, Pa. This is built in 2, 2½, 3, 3½, and 4 tons' weight for any gage of track. It has dual spring journal wheel suspension, permitting it to be used over rough and crooked tracks. It likewise is provided with four speeds in either direction up to 16 miles per hour. The gears are equipped with Timken bearings and run in oil in a dust-proof housing. Timken bearings are likewise used in the wheel journals.

For Pit and Plant Communication

For open-pit mines and outdoor installations about mine, mill, or smelter, the new outdoor telephone developed by the Kellogg Switchboard & Supply Company, 1066 West Adams St., Chicago, will be found of service. It is said to be one of the latest developments in this field and to have resulted from a long study of the needs of many diversified industries using outdoor telephones. Inasmuch as such telephones are often used on long, heavily loaded lines where transmission and ringing efficiency are important, provision has been made to permit any circuit arrangement necessary to secure proper transmission, reception, and ringing. The housing is weatherproof and ventilated to prevent sweating. All parts subject to damage by moisture are treated to withstand outdoor conditions.

Industrial Notes

Foxboro Company, Foxboro, Mass., has merged with the pyrometer division of the Wilson-Maeulen Company, after 25 years of cooperation between the two companies.

Grindle Fuel Equipment Company, a subsidiary of Whiting Corporation, of Harvey, Ill., has been absorbed by the parent company.

Whitecross Company, Ltd., Warrington, England, has recently completed the manufacture of what is claimed to be the largest steel wire rope in the world. This rope is 4⅜ in. in circumference and is 7 miles long in one continuous length. Its weight is 56½ tons.

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BULLETINS

Lubrication—The Lunkenheimer Co., Cincinnati, Ohio. Booklet on oil cups and oiling devices.

Hoists — Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1830, large electric hoists.

Magnets—The Ohio Electric Manufacturing Co., 5900 Maurice Ave., Cleveland, Ohio. Bulletin 125, "The Story of Ohio Separation Magnets."

Pump—Ingersoll-Rand Co., Cameron Pump Division, New York. Booklet "Motor Pump" for general service.

Air Compressors—Ingersoll-Rand Co., New York. Type 30 air compressors.

Scraping — Ingersoll-Rand Co., New York. Form 1860, Size 215; electric double-drum hoist for slushing.

Flotation—The Hercules Powder Co., Inc., Wilmington, Del. Booklet "Flotation Reagents Hercules."

Screens—Holman Bros. Ltd., Camborne, England. Catalog, "James Screens."

Portable Mills—Straub Manufacturing Co., 507 Chestnut St., Oakland, Calif. Bulletin No. 130, factory facts and figures about Rib-Cone plants, portable steel frame, frameless and standard.

Cyanidation—The Merrill Co., 343 Sansome St., San Francisco, Calif. Catalog, precipitation, cyanide recovery, clarifying and slime filters.

NEWS OF THE INDUSTRY

Camp Bird Companies Make Ore Reserve Estimates

Santa Gertrudis, Fresnillo, and Mexican Corporation, all companies affiliated with the Camp Bird group, have published revised estimates of their ore reserves, as at June 30, 1931. Lake George Metal, the Australian subsidiary formed to work the deposits at Captain's Flat, New South Wales, did no development work during the fiscal year ended June 30, its ore reserves remaining at a total of 2,880,000 long tons, proved and probable. A process is being developed for recovering sulphur from Lake George ore which, if successful, will be included in the plans for equipping this property. No attempt will be made to build the projected 1,000-ton mill until financial conditions justify.

With regard to the Camp Bird mine, in the San Juan district, Colorado, the lease held by the present operators on the ground between the surface and the No. 3 level has been renewed for three years, starting October, 1931. Camp Bird received £3,460 in royalties during its fiscal year, which was spent in maintenance and taxation.

Santa Gertrudis, second largest producer in the Pachuca district, Hidalgo, Mexico, milled a smaller tonnage of ore because of the exhaustion of the El Borde and Malinche mines, now closed down. Development in the Dos Carlos mine totaled 22,735 ft., of which only one-third was in ore. Because of the low price of silver and the unfavorable development, ore reserves are only 515,829 short tons, averaging 1.9 dwt. in gold and 21.2 oz. of silver per ton. This compares with 880,708 tons at the end of the 1930 fiscal year, when the grade was 1.6 dwt. in gold and 19.9 oz. of silver. Development of the new high-grade Mariposa vein was disappointing. Production of ore was about 20 per cent lower, but metal production dropped less than 10 per cent, due to handling a higher grade. Output of silver was 8,211,049 oz.; of gold, 35,291 oz.

At Fresnillo, Zacatecas, Mexico, development work was centered in the sulphide section of the Fresnillo mine. Oxide reserves dropped from 1,265,000 short tons to 781,531 tons. In addition, the company is including the 189,044 tons of material available in the Santa Ana dump, making a total of 970,575 tons that will eventually be put through the cyanide plant, or only 1½ years' supply. Sulphide reserves, including probable ore, were 1,385,700 tons of material averaging 8.7 per cent lead, 9.2 per cent zinc, 0.6 per cent copper, 9.1 oz. of silver, and 0.3 dwt. in gold to the ton, an increase of 400,000 tons over the total available at the end of the preceding year. Grade is somewhat lower.

During the year, excellent work was accomplished at Fresnillo in increasing the grade of lead concentrate from 52 to 58 per cent lead and of zinc concentrate from 50.7 to 52.1 per cent zinc. The total recovery of lead in concentrate was 97.8 per cent during the 1931 fiscal year, compared with 92.2 per cent the previous year. Inasmuch as sulphide-ore production costs were cut from $8.49 a ton to $6.77, this achievement becomes the more remarkable. Oxide-ore costs dropped from $1.80 a ton to $1.30.

At the Teziutlan copper-zinc unit, in Puebla, Mexico, which is operated by Mexican Corporation, ore reserves at June 30 were 159,535 tons averaging 3.2 per cent copper, 3 per cent lead, 17.5 per cent zinc, 3.5 oz. of silver, and 0.87 dwt. in gold per ton. Both grade and tonnage are higher than at the end of the previous year. The concentrator continued to handle about 180 tons of ore daily, making three different concentrates. Costs were cut from $12.17 a ton to $10.29 a ton, with further reductions at the end of the operating year.

■ ■ ■

Drop Lead Tariff Inquiry

The U. S. Tariff Commission announces that in accordance with Senate Resolution No. 88, adopted Dec. 14, 1931, the investigation heretofore instituted to ascertain the differences in costs of production of lead, pursuant to Senate Resolution No. 441 of the 71st Congress, has been discontinued and dismissed without prejudice. This investigation was instituted under the provisions of Section 332 of the Tariff Act of 1930 and the report of the results of the investigation was to have been made to the Senate.

Senator King, who introduced the original resolution, also offered the resolution to rescind the order for investigation.

■

Empire-Star Buys Murchie

Murchie Mines has been sold to the Empire-Star Mines Company, Ltd., subsidiary of Newmont, by the American Foundation and C. C. Van Loben Sels. The property, near Nevada City, Calif., was brought to its present successful position by O. McCraney, who was made resident manager some time ago. It now employs 150 men and is a steady producer of gold. Exploration and development exposed oreshoots of fair size. Flotation proved one of the factors that placed the property upon a profitable basis. The Empire-Star organization assumes control on Jan. 1, 1932.

■

Days Buy Crystal Lead Control

The Day interests, through a purchase of 400,000 shares of Crystal Lead Mines stock from Frank Fisher, are now in control of the property, on Eagle Creek, in the eastern section of the Coeur d'Alene district, Idaho. According to reports, the Days now have 800,000 shares, of 1,400,000 shares outstanding. Recent work done in No. 3 tunnel, on the property, has indicated about 200 ft. of ore. In addition, a new vein, 5 ft. wide, carrying 2 ft. of high-grade ore, has been opened. The holdings total ten claims, about three miles northwest of the Jack Waite mine.

The Day interests, prominent in Coeur d'Alene mining circles, control the Tamarack & Custer, Dayrock, Sherman Lead, and Hercules mill properties.

■

New Mexican Gold-Silver Taxes

Regulations governing percentages of values of gold and silver that the Mexican federal government will collect as taxes on production of these metals during next year, as announced by Minister of Finance, follow:

Gold: as metal, 10.5 per cent; in concentrates, 10 per cent; in precipitates or impure or mixed in bars, 9.25 per cent, and refined, 9 per cent when its official worth a kilo is 1,333.33 pesos a kilo. Silver: as metal, 7.5 per cent; in concentrates, 7 per cent; in precipitates or in bars, 2.75 per cent and refined, 2.50 per cent, when its official value is 26.65 pesos a kilo.

■

Rutgers Offers Research Work

To provide employment for engineers, P. H. Daggett, dean of the College of Engineering, Rutgers University, New Brunswick, N. J., has announced that he has received authorization for the appointment of six special research assistants for the spring term in the College of Engineering of Rutgers University. These assistantships will carry a stipend of $150 and exemption from all tuition fees. Four of these assistants will be used in part-time work on the following projects: (1) Study of the velocity of flow and sedimentation in tanks; (2) study of New Jersey sands for building purposes; (3) study of slag as a material for sprinkling filters; (4) breakdown law for rubber-insulated wires. The other two assistants will be assigned to problems to be chosen by the applicants.

Applicants for appointment must be graduates of recognized colleges of engineering and must present a certificate from the New Jersey State Committee of American Engineering Council that they are worthy of assistance in this emergency.

Colorado School of Mines graduates working in the Engineers' Lease at Cripple Creek

Smoot Urges Use of Silver for Debt Payments

In introducing Senate Resolution 1560, to permit foreign governments to pay their debts to the United States in silver at the current market price, Senator Smoot, of Utah, chairman of the Finance Committee, to which the measure was referred, said it was intended to relieve the "distressed condition of silver" and that he hoped there would be an international silver conference. "England and France will sooner or later come to the conviction that a conference will be to their advantage as well as that of the world," he said.

Senator Dill introduced Senate Resolution 1637 (referred to Finance Committee), creating a monetary conference committee of nine members, three each to be named by the President, Senate, and House, to meet with representatives of other governments which the United States may invite, for the purpose of agreeing upon silver as a monetary basis, its use in world exchange, and for payment of debts in silver so long as those countries continue to retain silver as a standard of value for money. The Senator said all countries should pay their debts in silver, as otherwise it would cause a dumping of silver into the United States and that private debts be paid in silver. "We should enlarge our currency system to provide a broader basis for the money of the world," he said.

Senator Pittman said silver could be restored to a normal price of 60 or 65c. an ounce through the action of governments in raising its standard of value. He said such a conference is desired by Canada, Japan, Australia, Mexico, China, and countries of South America and that such a conference should agree on the following program: maintenance of silver reserves; establish a standard of issue and fineness for fractional silver coins to facilitate their exchange; establish an exchange value for silver money in settlement of trade balances with silver-standard countries which would remove the uncertainty in silver values and remove the chief cause against credit transactions between countries where there is a violent exchange fluctuation; establishment by these countries of an embargo against imports of silver from countries not in the agreement.

■

Appoint Receivers to Conserve Interstate Zinc Assets

Ayers J. Stockley, of Wilmington, Del., and E. H. Gibb, of New York, have been appointed joint receivers for Interstate Zinc & Lead, owning mining properties in the Tri-State district. Mr. Gibb and John S. Ferrington, of Springfield, Mo., have been appointed joint ancillary receivers for the states of Oklahoma and Kansas in which the company's properties are situated. The receivership proceedings are a friendly action instituted by certain debenture holders and stockholders of the company to conserve its assets until such time as conditions warrant reorganization of the company and reopening of the mines, according to Mr. Gibb.

The company has outstanding $621,000 of 6 per cent debenture bonds of an issue of $1,000,000, issued several years ago. This issue has been reduced by the sinking fund, which is regulated by the payment of $7.50 a ton for each ton of concentrate produced. Interest on the bonds was paid at the last interest paying date. Capital structure of the company consists of 500,000 $1 par shares of stock, of which 431,000 are outstanding. Debts are said to be between $30,000 and $35,000, owed principally to supply companies in the Tri-State area. In addition, the company owes $25,000 to American Zinc, Lead & Smelting for money advanced.

C. F. Dike, of Joplin, manager of the company, has been placed in charge of its Tri-State affairs by the receivers. R. M. Atwater, Jr., of New York City, is president of the company.

The company owns the Hartley mine, which it purchased from Mr. Gibb and associates; the Cherokee and Woodchuck mines; and the Townsite lease. In 1929, production was 19,223 tons of zinc concentrate and 3,385 tons of lead concentrate.

Colorado School Graduates Find Work Under Leasing Plan

The number of graduates of the Colorado School of Mines employed on the Engineers' Lease, Colorado, under the plan evolved by the Alumni Association of the school, is being steadily enlarged, according to C. Lorimer Colburn, secretary of the Association. All graduates who apply are being furnished with work. Although applications have been received from graduates of other schools, preference naturally is being given to Colorado men. The association hopes to be able to help other mining-school men in the future.

Engineers Lease, Inc., holds three leases in the Cripple Creek district, one each in the Vindicator, Cresson, and Portland mines. Of the returns received for ore shipped to the Golden Cycle mill, at Colorado Springs, two-fifths is paid to the miners, two-fifths to the company, and one-fifth to the Alumni Association for originating, financing, and managing the plan. The miners are assured at least $1.25 a day for board and lodging. Their share of the net returns is divided on the basis of the individual's proportion of total shifts worked.

When the plan was originated, a prospectus was sent out to all Colorado School of Mines alumni, soliciting subscription to the stock. The response was sufficient to provide all the needed working capital. Work was started on the lease on the No. 8 level of the Vindicator mine on Sept. 15. The first carload of ore was shipped on Friday, Nov. 13. At the end of November, about 20 graduates were at work in the three leases, under the direction of Alex Walker, graduate of the class of 1912 and lease operator in the Cripple Creek district for several years.

■

Bond American Fork Mine

The Pacific mine, in American Fork Canyon, Utah, has been taken over by American Fork Gold Mining under a bond and lease to purchase for $55,000. The property consists of ten claims, which have produced $1,000,000 within a radius of 400 ft. along two major fissures. It is equipped with a gravity concentration mill to which two flotation cells have been added. The property will be operated on a leasing basis by a crew of eight men throughout the winter. The ore has averaged about 28 oz. of silver to the ton and 20 per cent lead.

■

Offer Mining Course at Seattle

The Annual Mining Institute of the College of Mines, University of Washington, at Seattle, will be held during the week beginning Jan. 18. Sessions will open on Monday morning at Mines Laboratory and will continue throughout the week. The courses are open to any person interested in mining or metallurgy, and no charge is made for any of the courses. In addition to the regular faculty of the College of Mines, speakers who are prominent in the industry in the Pacific Northwest will address the Institute.

Annual Meet of Northwestern Miners Held at Spokane

The 37th annual convention of the Northwest Mining Association and the fourth meeting of the Northwest sections of the American Institute of Metallurgical Engineers, held recently at Spokane, Wash., were serious and businesslike in aspect with little attempt to provide entertainment and amusement for the delegates. Little pessimism was talked. Convention speeches indicated that none of those engaged in the industry is quitting. Although many companies are curtailing or temporarily closed down, all expect to resume eventually on a larger scale. The various mine bureaus in the different states reported an increased interest in gold mining.

"I say that whoever believes the world will continue to progress will agree there will be an increased consumption of copper, and that the increased production contemplated in Africa, Canada, and Russia will be absorbed," said A. H. Richards, manager of the Tacoma smelter of A. S. & R. in an address before the engineers that was a highlight of the entire convention. "It is my belief copper will be sold at a comparatively low price the next few years and that production will be limited to those companies which can produce at low cost, but the ultimate future is bright."

The Metaline zinc-lead district was described by Lewis P. Larsen, president of Pend Oreille Mines & Metals. He said the ore is similar to that in Missouri, with low mining costs, and the rock softer at depth. Mr. Larsen said that large production can be expected in the Metaline area from ore already opened, and the indications are for further large bodies. Beginning production in November, 1930, the Pend Oreille company in ten months had mined and milled 64,242 tons of ore, with a metal content of 2 per cent lead and 9½ per cent zinc, he said. The zinc concentrates at times carried more than 62 per cent of the metal and averaged 60.16.

The two conventions came to a climax in the passage of four resolutions. One, reiterating the previous stand of the Northwest Mining Association, urges President Hoover to call an international silver conference. This resolution was also presented to the Western divisional meeting of the U. S. Chamber of Commerce, held in Spokane immediately following the mining meetings. It was passed by the Chamber at the urging of mining and silver men present.

A second resolution recommended an amendment to the income-tax law providing for the allowance for depletion in mining operations upon the basis of a percentage allowance computed upon net profits, the percentage to be sufficient to return to the taxpayer of his capital tax free.

A committee to investigate legislation affecting the sale of mining securities in the State of Washington was provided in a third resolution. A fourth called on Congress to amend the mining laws of Alaska.

During the meeting a telegram assuring support in his new office was sent to A. B. Parsons, new secretary of the A.I.M.E.

Officers of the Northwest Mining Association were elected as follows: president, R. T. Banks; vice-president, L. K. Armstrong; treasurer, Charles T. Goodsell; secretary, Leon Starmont—all of Spokane. These with the following form the board of trustees: A. H. Richards, Tacoma; A. E. Drucker, Pullman; F. A. Thomson, Butte; E. W. Widdowson, Nelson, B. C.; A. W. Fahrenwald, Moscow, Idaho; Donald A. Callahan, Wallace, Idaho; Frank M. Smith, F. Cushing Moore, Conner Malott, C. H. Hussey, and D. M. Drumheller, Jr., Spokane.

■

Cotter Butte Officials Guilty

Harry C. Cotter and Frank E. Metterlecher have been found guilty of mail-fraud conspiracy by a federal court in the government investigation into the promotion of Cotter Butte Mines, a company holding ground in the Butte district, Montana. Cotter was formerly president and Metterlecher was secretary of the now-defunct organization. The jury failed to reach an agreement on George F. Ewald, former New York City magistrate, who was a director of the company. F. M. Schirp, another former director, was found not guilty of conspiracy.

■

Golconda Prepares Another Exit

Work of putting up a raise from the 1,400 level of the Golconda Lead mine, in the Coeur d'Alene district, Idaho, has necessitated adding about fifteen men to the operating force. Sufficient lead-zinc ore is being broken in the raise and in other development work to keep the 200-ton mill running one shift a day. Proceeds from concentrate are sufficient to cover expenses.

The new raise is east of the fault on the 1,400 level and extends for 40 ft. along the new orebody recently opened up at that point. This unusual size provides storage for waste and ore as the raise proceeds upward. The raise will be continued to the 1,200 level, and, possibly, to the 1,000 level, so as to improve ventilation and provide a second exit. Golconda is now developed through a tunnel on the 1,000 level, from which the main shaft has been sunk to the 1,800 level. The new ore east of the fault at 1,400 ft. has now been opened for a length of 400 ft., and an average width of 7 to 8 ft.

■

Few Large Shippers to Trail

Publication by Consolidated Mining & Smelting of a list of the ore receipts at its smelter, Trail, B. C., during the eleven months of 1931 ended Nov. 30 shows the effect of low metal prices on small British Columbia mines. Only two properties shipped more than 1,000 tons to Trail during the eleven months—the Bell silver property, which shipped 1,678 tons of high-grade ore from its mine at Beaverdell, and the Union silver-gold mine, operated by Hecla Mining, at Lynch Creek, B. C., which shipped 1,484 tons of concentrate. Union also shipped some high-grade gold ore to the Bunker Hill smelter in Idaho.

The Wellington mine, near the Bell, at Beaverdell, shipped 659 tons and the Knob Hill silver-gold property, at Republic, Wash., shipped 838 tons. No other mines shipped more than 500 tons, although 37 different mines are in the list. Most of these mines are either in central and southern British Columbia or in northern Washington. Company mines in the same period shipped 353,062 tons of ores and concentrates. Most of this was lead or zinc concentrate from the Sulivan property, largest lead-zinc producer in the world.

■

Describes Coppermine Deposits

Gordon Duncan, director of exploration for Northern Aerial Minerals Exploration, operating in northern Canada, describes the Coppermine River bornite deposits in the annual report of the company. During the 1931 season, the company had a crew of men working on the deposits. No. 1 trench showed a width of 15 ft. with an average grade of 47.1 per cent copper. About 70 ft. south, another trench showed 9 ft. averaging 44.6 per cent copper. Still another trench, 170 ft. south, showed two bands of ore—one 3 ft. wide and the other 1 ft.—with assays of 25.6 and 35 per cent copper, respectively. A diamond drill has been transported to the property, with sufficient gasoline and supplies for next season. On "D" group, trenching indicates disseminated chalcocite, averaging 9 per cent copper, over a length of 1,100 ft. and a width of 8 ft.

N.A.M.E. has staked ground in the Great Bear area, where radium and silver dedosits are being developed. The company's airplanes may be sold, as commercial companies can now supply adequate service.

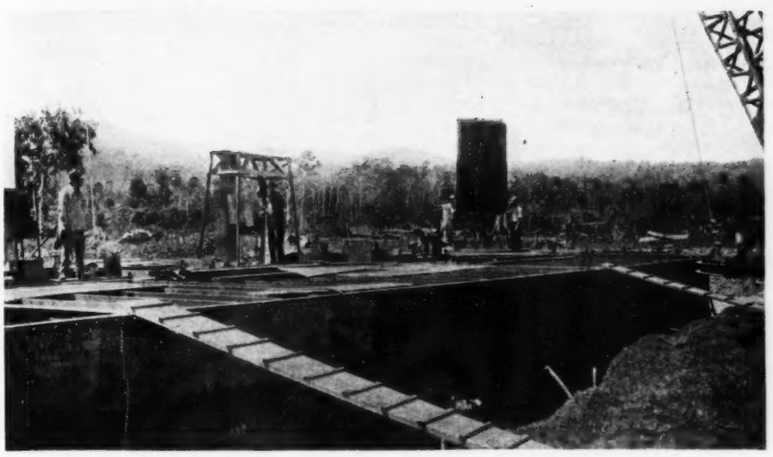
■

Two New Finds on Comstock

Sutro Tunnel Coalition Mines, operating subsidiary of Comstock Tunnel & Drainage, reports that it is developing a newly discovered shoot or lens of gold-silver ore in its Crown Point mine near Virginia City, Nev. This shoot is south of the orebody developed in Crown Point during the past year and was found by crosscutting from the south drive, on what is called the third level, about 90 ft. south of a winze, sunk below the so-called Crown Point tunnel. The ore opened in this development has averaged 0.375 oz. gold and 15 oz. of silver per ton, for the width of the drift. Its full width and lateral extent have not yet been determined.

Charles E. Eagan, operating for a Pacific Coast group in the Andes shaft on Consolidated Virginia ground, reports the opening of a 6-in. streak of high-grade gold ore in an orebody 8 ft. wide, from which he has recently started shipping. This ore is being developed from the 175 level of the Andes shaft. The ore shipped to date has yielded from $20 to $30 in gold and silver per ton.

The objective of the Eagan development is to drive an east development and exploratory crosscut from the 520 level of the Andes shaft to intersect and explore the lode in Consolidated Virginia ground.



Assembling steel hull of one of the new dredges of Bulolo Dredging, near Wau, New Guinea. All of the equipment here shown has been transported by plane from the coast

Eagle Picher Buys Adams and Absorbs Consolidated

Stockholders of Consolidated Lead & Zinc have approved the sale of the company's assets, except a cash item of approximately $85,000, to Eagle-Picher Mining & Smelting for 80,000 shares of Eagle-Picher stock, according to an announcement on Dec. 11, by Fred N. Bendelari, president of the Consolidated. The Consolidated company will continue to maintain its corporate entity as a holding company, Mr. Bendelari announced.

The company owned eight mines and mills in the Tri-State district and for several years has been one of the largest producers of the district. Eagle-Picher has also purchased the Adams mine, belonging to the Harry Payne Whitney estate, for a consideration said to be less than $100,000. The Adams mill was erected several years ago at a cost of nearly $300,000. It is an all-steel plant with a rated hourly capacity of 60 tons. Included in the transaction are a 40-acre fee and leases on 360 acres of the Xavier and Mudd Indian lands.

Consummation of these two transactions erases the last obstacle to the erection of a 3,600-ton capacity central mill in the Tri-State district by Eagle-Picher. The plant will be built on the south side land of the company in the southern end of the Picher district. Ores from some twenty leases in the district will be milled at this plant.

■

P.D. Men Discuss Safety Work

Safety work was the subject of discussion at a dinner given 75 executives, foremen, and bosses of the Copper Queen branch of the Phelps Dodge Corporation at Bisbee, Ariz., on Dec. 12, by Capt. J. P. Hodgson, manager of the mining division. Addresses were made by H. C. Henrie, manager of the labor department; A. C. Reifsnider, superintendent of the mechanical division, and Mr. Harris, also of the mechanical division; and Fred Juliff, safety engineer. H. M. Lavendar, mine superintendent of the branch, spoke for the C.&A. men who have become Phelps Dodge employees and Captain Hodgson acted as toastmaster.

Postpone Nipissing Decision on Beattie Financing

A meeting of Nipissing Mines in Toronto called to vote on proposal of the company to purchase shares in Beattie Gold Mines Company, adjourned until Dec. 28, although the management had a comfortable majority. The proposal to purchase into Beattie Gold Mines was outlined as follows: Nipissing to make a cash loan of $280,000 to Ventures, Ltd., with security, at 6 per cent. Also to buy 1,000,000 shares in Beattie Gold Mines at 40c. a share; option 300,000 further at 40c. and option 600,000 at $1 a share.

E. P. Earle, president, said at the meeting: "I challenge anyone here to find another gold mine on this continent where it is more than reasonably sure we are going to get our money back without risk, and with good chances of getting it back many times. Developments in two more deep drillholes have added considerably more ore at greater depth."

The management had proxies for 613,000 shares and the opposition 240,175 shares.

■

Placers Bring Life to Octave

The old buildings at Octave, Ariz., are again being occupied after being empty for several years. Octave is about 10 miles east of Congress Junction, and the surrounding placer district is credited with having produced more than $2,000,000 in gold in former years. Now the Yavapai Gold Mines Company, Ltd., of Los Angeles, Calif., has tested the high banks and mesas adjacent to Weaver Creek in the Octave area and is reported to have spent $20,000 on a placer plant to handle this ground. Sufficient water has been piped in through a 9-mile pipe line to permit the operation of 200 ft. of sluice boxes. A steam shovel is loading the ground from the high banks into cars, which are hauled up an incline and dumped into a bin from which the ground is fed into the sluice boxes. Several men in the district are working their claims with dry washers. The buildings at the old Octave mine are still in good condition and are housing about six families. There are a post office and a school, which is attended by twenty children.

Two Hundred Claims Staked in New Island Lake Field

The scene of the latest Canadian gold rush is at Island Lake, a body of water containing some thousands of islands, about 150 miles east of Norway House, at the northern end of Lake Winnipeg, 150 miles south of Picket, on the Hudson Bay Railway, and 250 miles northwest of Sioux Lookout, on the Canadian National Railway. Discoveries are in Manitoba close to the Ontario boundary. The district is not a new one, because, on account of its geological formation, the country has been prospected from time to time during the last few years. The first discoveries were made during the latter part of November and all discoveries have been made on islands. Practically all the prospectors have been going in and out by airplane. During the week ended Dec. 12, six planes were at Island Lake at one time. The first discoveries were made by J. G. Raehill and H. S. Cowan, and to date about 200 claims have been staked. Grab samples run from $20 to $1,000 in gold a ton, and indications point to the veins being high grade and of considerable size.

■

Ray Negotiates for Power

Negotiations are being carried on between the Salt River Valley Water Users' Association and the Arizona division of Nevada Consolidated Copper at Ray, Ariz., for an agreement on delivery of power to the copper company's mill at Hayden. Power is usually supplied to this plant from the power plant at Coolidge dam (which is not a part of the Salt River project). Recent rainstorms have made it possible to irrigate the San Carlos project without drawing any water from Coolidge dam, so that the power supply from that source is intermittent. The Salt River project now has surplus power, since so many of the mines which are its regular customers for power are shut down. Under the new agreement the Water Users would furnish the company power at the price that concern would have to pay were it generating its power by steam. Power would be furnished in this way only so long as it is not feasible for the copper company to get power from the Coolidge dam. The agreement would probably net the Water Users about $8,000 per month for six or eight months out of the year.

■

Look for Gold Near Yaqui River

Gold rushes have been inspired in northwestern and north central Mexico by reports of promising strikes of the precious metal in those areas. Numerous persons from various parts of Mexico have flocked to a branch of the Yaqui River, near the town of Cumuripa, Sonora, where a placer gold strike is said to have been made. Prospectors are making a fair living by employing primitive methods. An intensive search for gold deposits is reported in various sections of Chihuahua, principally in the Dorada and Las Animas districts.

BRIEF NOTES

A.S.&R. Curtails at El Paso. American Smelting & Refining shut down the lead furnace at its El Paso smelter, in Texas, on Dec. 1. Operations will be resumed on Jan. 1. The plant depends largely on ores and concentrates from northern Chihuahua and New Mexico for its operations. Suspension of production by Ahumada at Los Lamentos has curtailed the supply.

B. H. P. Options Enterprise. Broken Hill Proprietary has taken an eighteen months' working option over the Enterprise gold mine at Kalgoorlie, Western Australia. The mine adjoins Great Boulder, South Kalgurli, and North Kalgurli. Terms of the options have not been published. Broken Hill is understood to have secured permission to drive from the 1,600 level of the Great Boulder mine.

Chief Resumes at Apex. Operations have been resumed at the Apex Standard mine of Chief Consolidated, near Tintic, Utah. The shaft has been repaired to the 900 level, where one crew is already at work, and timbering and caved ground is being caught up in other places. The shaft will be sunk a short distance below the 900 level and drifting done to see if a gold deposit similar to that in the adjoining Eureka Standard property cannot be found.

Ford Mining Gets Equipment. Mine equipment has been delivered to the property of Ford Mining, near San Andreas, Calif. It consists of pumping and compressor units. The company now plans construction of a 50-ton mill.

Golden Reopens Raymond. Golden Tintic Mining, an organization of Colorado mining men, is reopening the old Raymond Illinois property, in the Tintic district, near Eureka, Utah. The property, totaling 15 patented claims, has been idle since 1914. A tunnel is being driven to connect with an old 1,500-ft. shaft. Development will be in the quartzite formation, where the company hopes to find gold ore.

Holden Resumes Work. Work has been resumed on the property of Holden Gold Mining, between Methow and Carlton, Wash. The company, owned principally by S. J. Holden, of Chelan, Wash., holds an area of 200 acres, developed through a 160-ft. shaft and a tunnel. A small mill will be built to treat ore in sight.

International's Sacramento Work. International Smelting, Utah subsidiary of Anaconda Copper, is starting a new tunnel at the Sacramento Gold & Quicksilver property, at Mercur, Utah. The tunnel is 150 ft. below the old workings and is being driven to prove the continuation of low-grade gold ore at depth.

Jumbo Ex. Reorganizing. Reorganization of Jumbo Extension Mining, a Nevada company with headquarters in Reno, is proposed in a letter to stockholders from Ben Gill, secretary-treasurer. The reorganization, which would include raising of about $30,000, would provide funds for financing development of the claims in the Gold Coin group, at Goldfield. Two shares of new stock would be exchanged for one share of the old, under the reorganization plan.

Lakeland Continues Work. Development operations by Lakeland Gold at its property, northwest of Kirkland Lake, Ont., has indicated five gold-bearing veins. In no place has the grade been sufficiently high to be considered ore, but the company believes that work at depth will show an improvement. Two shafts are now 150 and 200 ft. deep. The oil-fired plant can operate to 1,000 ft.

North Lily Drifting West. From the Big Hill shaft of North Lily-Knight, Anaconda-controlled company in the Tintic district, Utah, a drift is being run to the west to open up the Big Hill, East Tintic Coalition, and other claims, including ground recently acquired from Chief Consolidated. Present plans call for a drift 2,500 to 3,000 ft. long. This work will not interfere with that on the 1,900 level, where a drift has been run into Eureka Bullion ground.

Notla Talc to Expand. Diamond drilling is reported to have revealed additional deposits of high-grade talc on the Notla Talc property, near Murphy, N. C. Plans for plant enlargement are under way. The last few months have shown a steady increase in the company's business, according to J. W. Baily, general manager.

Panique Reduces Costs. Panique Mines, which purchased the Syndicate Mining property, in Masbate, Philippine Islands, in August, has cut costs considerably by changes in mining methods which have reduced the labor requirements. At present the company is treating about 160 tons of gold ore daily by the cyanide method, obtaining a large part of this tonnage from old stope fill, according to R. B. Mahan, mine superintendent. Although the grade of ore is only $3.20 in gold per ton, mining costs are 70c.; milling costs, $1.25; and general overhead 30c. per ton—a total of $2.25. Paul Schwab is president and general manager.

Phelps Dodge Closes 85 Mine. Phelps Dodge Corporation has decided to close down its 85 mine, at Valedon, N. M., on Jan. 1, because of the low price of copper. The 85 mine is the largest producer in the Lordsburg district, having shipped 80,561 short tons of ore in 1930, average grade being 2.74 per cent copper. It was one of the properties of Calumet & Arizona absorbed in the recent merger of P.D. and C.&A. The ore, which had a comparatively high precious-metal content, was valuable because of its siliceous qualities in the operation of the C.&A. smelter.

Quincy Smelter Running. Although the mine has been closed for more than two months, the Quincy Mining copper smelter, near Hancock, Mich., is still in operation. The plant is treating accumulated stocks of concentrate, which will be exhausted early in January. It will then close.

Rowan Mining Formed. Rowan Mining, recently formed at Salisbury, N. C., filed papers on Dec. 15 leasing 1,242 acres of ground near Gold Hill. The company is now operating on a small scale.

Santa Rosa to Add Men. Santa Rosa Mines Development expects to increase its working force at its property near Keller, Calif. A carload of silver-lead ore is being shipped each week. A new 120-hp. semi-diesel engine has been installed.

Shattuck Mine Leased. C. V. Toll and Leonard Koch have taken a lease on the Shattuck mine, of Shattuck Denn Mining, at Bisbee, Ariz. This property, a copper-lead producer, has been shut down for more than a year because of low metal prices. Installation of an electric hoist, used at Tombstone leases, is being completed prior to development.

Sherritt Gordon Cuts Wages. Wages of workers at the Sherritt Gordon copper mine, in northern Manitoba, Canada, were reduced 10 per cent in November. The company has no intention of closing at present, according to Halstead Lindsley. Tonnage has recently been about 800 tons of ore daily.

Trepca Output a Record. November mine production of Trepca Mines, operating in Jugoslavia, was 25,951 metric tons of ore, a new high record average of 865 tons daily. Concentrate output was 3,319 metric tons averaging 77 per cent lead and 31.3 oz. of silver per ton; and 3,815 tons averaging 50.4 per cent zinc.

Virginia Dare Buys Climax. The Climax group of seven claims, 17 miles southeast of Prescott, Ariz., has been taken over from J. H. Richmond, of Phoenix, by Virginia Dare Mining, of which H. W. Greene, of El Paso, Tex., is president. The property, a former gold producer, has been developed on three tunnel levels. Total extent of workings is about 5,000 ft. The new operators are repairing the surface plant, consisting of a Corliss engine, an air compressor, and a ten-stamp mill.

Washington-Idaho in Ore. Crosscutting of the No. 1 vein, west of the dike, on the 225 level of the Washington-Idaho property, on Moon Creek, in the Coeur d'Alene district, Idaho, shows ore 4 ft. wide, according to Stewart Campbell, state mine inspector. The ore is being drifted on at present. The ore is largely lead-silver, but some copper and zinc are also present. On the 300 level, the crosscut has intercepted three veins, the first two of which show galena stringers and the third of which is a great mineralized shear zone, with occasional small streaks of galena.

Wanderer Reserves Drop. Wanderer Consolidated, operating in the Selukwe area, Southern Rhodesia, reports ore reserves of 500,000 tons at June 30, 1931, compared with 648,000 tons at the end of the previous fiscal year. Development indicates that the orebodies are not so regular as had been thought and that plans for enlarging mill capacity, now 500 tons a day, had better be postponed until more knowledge of the deposit has been obtained. Production in the fiscal year was 182,651 short tons, yielding £191,113 in gold. Costs are lower than in any other gold mine in Rhodesia, at 13s. 11.5d per ton.

Mufulira Not to Start Mill in Rhodesia Next Year

Mufulira Copper Mines, one of the three operating companies that have recently been active in developing Northern Rhodesian copper deposits, will not put its new concentrator, now under construction, into operation in 1932, as had originally been planned. This decision has been taken as a result of a conference between the three Rhodesian companies, the development of which has been one of the most important features of recent copper history. Mufulira is owned by Rhodesian Selection Trust, Rhokana, and British South Africa, which have holdings of about 60, 30, and 10 per cent respectively. Rhodesian Selection Trust is controlled by the same interests as Roan Antelope, one of the three operating companies, which has been producing since June. Rhokana is itself the third of the operating companies.

According to the agreement, Mufulira will not produce in 1932. Instead, the output allowed to it under the recent curtailment plan adopted by leading copper producers will be shared by Roan Antelope and Rhokana. This will mean that Roan and Rhokana will produce at a rate higher than 26½ per cent of their capacities and will be able to make important operating economies. Mufulira had originally planned to build a 6,000-ton mill, but last spring decided to proceed with construction of the initial 1,500-ton unit only. The company has total reserves of 162,000,000 tons of ore averaging 4.14 per cent copper.

As Mufulira is owned by the same interests that control the two plants now in operation, the three operating companies are agreed that much is to be gained by producing the Rhodesian quota in two plants instead of three. Rhokana has just started its plant. Rhodesian Selection Trust has announced that arrangements with Mufulira Copper and Roan Antelope provide that the profit from the sale of about two-thirds of the Mufulira quota will accrue directly to Rhodesian Selection Trust. There are no individual shareholders in Mufulira at present.

■

Hoover Pledges Further Aid to Fund for Jobless Engineers

President Hoover, who recently donated $5,000 to the Professional Engineers Committee on Unemployment, has expressed his willingness to be of further help to the committee in its relief activities, according to an announcement by H. de B. Parsons, general chairman.

Acknowledging a letter from Mr. Parsons, expressing the thanks of the engineers for his assistance, Mr. Hoover replied:

"It was very kind of you to write your letter of Dec. 10. I am indeed glad to be of help, and will be glad to be of further help in any other way you may suggest."

The committee was recently organized by the New York Sections of the four national engineering societies, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the A.I.M.E. Under the general leadership of Mr. Parsons, a professor emeritus of Rensselaer Polytechnic Institute and a civil engineer of 26 Beaver St., the organization is functioning through an executive committee, of which J. P. H. Perry, vice-president of the Turner Construction Company, is chairman; a finance committee, and a relief committee.

Approximately 900 unemployed members of the engineering profession have registered with the committee, which has headquarters in the Engineering Societies Building, 29 West 39th St. According to a recent estimate, 2,000 cases will be handled by the committee before spring 1932.

More than $37,000 has been raised and pledges have been received for a considerable amount in addition. About $200,000 is required to carry out the relief program.

Funds are being solicited and members of the Four Founder Societies are also being urged to find jobs for the destitute.

■

Roan Costs Cut Further

The depreciation in the pound sterling and the increase in the scale of operations enabled Roan Antelope to cut its costs further in November, according to A. Chester Beatty, chairman of the board of directors of the company, at the annual meeting in London on Dec. 18. In that month, the cost for 4,362 long tons of copper was £30 3s. 6d. a ton, exclusive of depreciation and interest charges. This compares with the November average price of £41 a ton for electrolytic copper on the London market. Standard copper averaged £36 a ton in November. The plant now has a proved capacity of 75,000 tons copper a year. The company will curtail in accordance with the recent agreement adopted by leading copper producers, but because of the decision of Mufulira Copper to postpone starting its new mill, Roan will not have to make the full curtailment to 26½ per cent of capacity.

■

Evans-Wallower Closes Plant

Evans-Wallower has suspended operation of its electrolytic zinc plant at East St. Louis, Ill. This plant, built two years ago, is the second unit using the Tainton process erected in the United States, the first having been put up at Kellogg, Idaho, by Sullivan Mining. Suspension is believed to be the result of financial troubles, precipitated by the drop in the price of zinc.

The original plan, which this unit was erected, was to treat concentrate from Far West mines, using material from the Tri-State district only to maintain capacity operation. However, the mines acquired by the company, at Leadville, Colo., did not possess sufficient reserves that could be economically treated, and the company was forced to fall back on Tri-State concentrate. Because the latter material carries virtually no byproduct silver, the company was handicapped in competing with other electrolytic producers. Production was never maintained for any considerable period at the rated capacity of 50 tons a day. In the last three months of 1929, in which year operations started, output was 1,634 short tons. In 1930, output was 9,516 tons. Data on 1931 output have not been published.

Munroe Reports on Progress Underground at Rhokana

H. S. Munroe, consulting engineer, says in the Rhokana annual report that up to June 30, 48,793 ft. of underground development work had been completed in the N'Kana mine, in Northern Rhodesia. A main five-compartment shaft has been put down near the center of the North orebody. Main haulageways have been driven on the 450 and 600 levels. On the 450 level they had been driven 6,523 ft., and 1,500 ft. remained to be driven. Mine development had been so well advanced that there would be no difficulty in supplying the plant when and as required. Experience has shown that the mining problems to be solved are not unusual, and that simple, economical methods can be employed. The general average of water pumped to the surface does not exceed 1,250,000 gal. per day. In the pilot mill, about 93 per cent of the copper content of the ore was recovered in a high-grade concentrate by standard flotation methods.

The geological survey of the Rhokana concession has been continued, from eight to thirteen parties being constantly in the field. A large syncline of the ore-bearing series has been located north of the Lunsemfwa River, but in view of the large reserves elsewhere this probably will not be drilled for some time. Farther east alluvial gold is distributed over a considerable district, but no payable deposits or the source of the gold has been discovered. The supply of native labor is ample. Health of European residents has at all times been good, and more rigid rejection of unfit recruits has improved the general health of colored workers.

The tonnages and grade of ore in the Rhokania deposits is now calculated as follows:

	Tons Ore	Copper, Per Cent
N'Kana North	45,000,000	4.6
N'Kana South	15,000,000	2.95
Mindola	67,000,000	3.8
N'Changa West	46,500,000	6.9
N'Changa River Lode	2,280,000	4.2
N'Changa	93,000,000	3.51
Chingola	2,000,000	7.0
Totals	270,780,000	4.3

Engineers have computed that the above-listed deposits contain 11,788,560 short tons of copper. In this total no Mufulira ore (in which Rhokana has approximately a one-third interest through stock ownership) is included, nor is any ore in the King Edward, Chifumpa, Mimbula, or other outlying properties.

■

Tom Reed Opens Ore in United

A winze from the 900 level of the United American workings, at Oatman, Ariz., has cut ore that runs as high as $60 a ton in gold over a width of 6 to 7 ft., according to reports from the Tom Reed management. Tom Reed recently took over the United property. In addition, on the 600 level some new ore of mill grade has been opened near the Black Eagle workings. Tom Reed, now the largest gold producer in Arizona, plans to connect the United American winze with its own 1,100 level workings. Stopes on the 1,100 and 1,200 level are furnishing most of the present mill tonnage.

The flotation plant of Combined Metals, at Bauer, Utah, which treats carbonate and sulphide lead or lead-zinc ores

Urquhart Discusses Mining Trust

London, Dec. 23.—At the meeting of Mining Trust shareholders on Dec. 17, Leslie Urquhart, chairman of the board of directors, discussed the various properties in which the company is interested. Construction of a 100-ton pilot mill to treat ore from the lower area at the New Guinea Goldfields property, near Wau, New Guinea, is progressing rapidly, and production is expected to start May 1. The power plant is virtually completed. Two shafts in the plateau level that have reached water level indicate at least 300,000 long tons of oxidized ore assaying 13 dwt. in gold and 19 oz. of silver per ton. The lower area ore averages 1 oz. in gold and 3.5 oz. in silver per ton. Tests indicate treatment costs of 20s. per ton and a recovery of about 90 per cent of the gold content.

. . . . Production of the new Britannia lead refinery, on the Thames, England, to date of meeting was 3,937 long tons of lead and 190,000 oz. of silver. Present capacity of 75,000 tons of lead annually can be doubled for £20,000. Production at Mount Isa will be increased to 6,000 tons monthly. The Lawn Hills concession, in Northern Queensland, is being abandoned. It contains several lead-silver and lead-zinc deposits. In Northern Rhodesia, where the company has been prospecting, results have been poor. At the Villemagne property, extraction is being confined to high-grade ore, but even so operations are at a loss.

■

Errington Work Suspended by Treadwell Yukon

Operations are being entirely suspended at the Errington zinc-lead property, in the Sudbury district, Ontario. This mine, owned by Treadwell Yukon, has been on a development basis only for the last year, as the mill was closed down late in 1930. Work recently has centered on the 1,500 level, where the company has been looking for the downward extension of the low-grade orebodies opened at 300 and 500 ft. Recently some lead-zinc was struck at 1,500 ft., after a long and hitherto fruitless search, but evidently the showing was not of sufficient importance to justify continuation in the face of depressed metal markets. Pumps are being pulled.

Treadwell Yukon has had ambitious plans for its Errington mine. On the 500 level, a large tonnage of low-grade ore was indicated, which justified construction of a 300-ton concentrator. This plant, in operation for two years, produced three concentrates—copper, lead, and zinc, of which the last was by far the largest in point of volume. Results were sufficiently encouraging, despite a grade of only 5.8 per cent zinc and about 1 per cent each of copper and lead, to warrant planning for enlargement to a scale of 2,000 tons of ore daily should the 1,500 level open ore similar to that on the 500 level. The company intended to build a copper-lead smelter and an electrolytic zinc plant.

■

New Mexico Potash Deposit Covers Wide Area

Most of the present development of the United States Potash Company, at Carlsbad, N. M., is on land owned by the federal government, but leases held by the company also apply to more than thirty sections of State land, according to a recent announcement of J. F. Hinkle, land commissioner of the State. Although the extent of the potash deposit is unknown, an 8-ft. stratum, he says, underlies nearly all of Eddy County and parts of Chaves and Lea counties, assuring potash consumers of the United States sufficient of the product to make them independent of foreign sources for an indefinite period.

Excavation work on a four-compartment shaft was started by the United States Potash Company in December, 1929. Within a year the shaft was carried to a depth of 1,062 ft., at an estimated cost of $250,000. A commercial bed of sylvite was struck at 980 ft., drifts were driven, and actual production started early in 1931. The first carload was shipped Jan. 10, 1931, to Wilmington, Calif., for experimental use. The first commercial shipment in March, 1931, was to the Dothan Guano Company, of Dothan, Ala. As mined it averaged 26.80 per cent K_2O.

At present the ore is mined from the 1,000-ft. level, hoisted to the surface, ground, screened through 8-in. Cole screens, and then loaded on cars of the Atcheson, Topeka & Santa Fe R.R., which has built and operates a five-mile spur line between the potash mine and the main line of the Santa Fe near Loving, N. M. In August, output was 11,000 tons of ore. The capacity of the shaft has been shown to be in excess of 500 tons per day.

C. & H. Kearsarge Developments Continue Favorable

The Kearsarge lode appears to be opening well at great depth in Calumet & Hecla lands, near Calumet, Mich., grade being quite consistent in long openings north and south from the No. 78 level crosscut of No. 12 conglomerate shaft in the south end of the tract, and from the No. 81 level crosscut of the Red Jacket shaft in the north. A stockpile of development ore is being accumulated near No. 12 shaft, and a mill run of this ore probably will be made at some future time.

If it becomes necessary later to use two old Kearsarge lode shafts near the development for further opening of the lode at depth, they may be drained by holing through. These shafts, Nos. 19 and 21, have been idle since 1913 and are filled with water. They are comparatively shallow. This Kearsarge lode development at great depth has important possibilities. Along with Centennial, and the development of the conglomerate below the No. 81 haulage level and to the north, it is considered one of the bright spots in Calumet & Hecla's future.

At Calumet & Hecla's Centennial No. 2 shaft, drifting is proceeding in bottom levels. This shaft was originally bottomed at the No. 35 level, but was holed through from the No. 43 level and completed after the No. 43 level had been driven south under Centennial from North Kearsarge No. 1 shaft. Inasmuch as there are eight levels to develop, no further sinking will be necessary for some time. Ground of good stoping quality is being developed, particularly north of the shaft. The work now being done will provide reserves for the future, when the metal market is such to warrant production from this branch of the Kearsarge lode.

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Would Abandon Cordes Track

The Santa Fe Railway has asked the Arizona Corporation Commission to allow the abandonment of 10 miles of track between Cordes and Middleton, Ariz., on the ground that the road has not paid a profit since 1922 and that immediate repairs costing $25,000 are necessary if the stretch is to be maintained. The hearing was held in Prescott, and several mining men were present to protest against the abandonment, as about twenty mining properties are situated along the road.

MARKET AND FINANCIAL NEWS

Copper Agreement Restricts Production to 26½ Per Cent of Capacity

Copper producers representing about 90 per cent of the world's output have agreed to curtail production to approximately 26½ per cent of estimated capacity. Modification of the rules of Copper Exporters, Inc., also has been decided upon, and, it is believed, provision has been made to prevent the curtailment in production from being utilized to advance prices unduly. Announcement of the agreement that is to become effective Jan. 1, 1932, was made by the Copper Institute on Dec. 22.

Negotiations looking to a satisfactory plan to check the further accumulation of supplies of copper began on Oct. 22 last. The views of the various factions that make up the copper industry were given a thorough airing, and on more than one occasion during the last two months all hope for an understanding was abandoned. The final agreement is expected to bring copper production down to about 85,000 tons a month, a figure calculated to be sufficiently low to more than balance production and consumption. The huge stocks of refined copper now above ground, estimated in some quarters at more than 550,000 tons, may hang over the industry for some time, so that a runaway market for copper is hardly conceivable unless world business conditions show marked improvement in the near future. Producers, according to trade opinion, are strongly in favor of an orderly market for the metal, and the most optimistic members of the fraternity would be highly pleased with an 11c. or, perhaps, 12c. basis for copper.

The statement on the agreement, as announced by the Copper Institute, follows:

On Nov. 15, 1930, the Copper Institute, acting informally, announced a voluntary curtailment of production, which at the time was thought would be sufficient under existing conditions of consumption to prevent further demoralization in the copper industry. Notwithstanding that such reduction was generally effected, consumption continued to decline, with the result that the situation became increasingly more difficult, until the present time, when stocks have accumulated to the highest level in history, and the price has fallen to 6½c. per pound, much below the lowest level of all times, and generally below the actual money cost of producing copper, exclusive of any depreciation or depletion of capital assets. A large new production in Rhodesia is also about to come upon the market, operations having already been started.

It was obvious that unless there was a more drastic curtailment of production the price of copper would continue to fall to levels under which no operating mine could meet expenses. Another meeting was therefore called, attended by representatives of practically all copper-mining companies of the world, including the new Rhodesian producers, many of whom are not members of either the Copper Institute or Copper Exporters, Inc. These representatives were of the unanimous opinion that further reduction in production was inevitable, either voluntarily or through the compulsion of a price inadequate to meet the cost of production, forcing a shutdown by producers one by one, beginning with the higher cost units, most of which are situated in the United States.

After discussion as to a proper basis for proposed reduction, a consensus of opinion was reached that operations ought to be reduced to a basis of approximately 26½ per cent of estimated capacity, beginning Jan. 1, 1932. No formal agreement has been made; there is no authority to enforce the reduced rate of production, nor is there any restraint that prevents any individual action that may be taken by any company. In these discussions, over 90 per cent of the world's production was represented, of which approximately 70 per cent is from mines situated outside the territorial limits of the United States.

In order that the reduced operations contemplated in the discussions may not result in unduly advancing the price of copper, it was the view of all of the producers that curtailment should cease when the total stocks of copper above ground shall not equal in the aggregate the total of the deliveries in the preceding four months. The processes of production, from mine through smelting, refining, transportation to market, normally require the tie-up of an amount of copper in tonnage roughly equal to three times the current monthly rates of delivery.

Twelve cents a pound was approximately the lowest level reached by copper during the present century prior to the present depression. It is a price below which but few mines—only one or two of which are situated in the United States—can be operated at a profit allowing a return of the capital invested with 6 per cent interest thereon. In order to prevent the curtailment from being utilized in unduly advancing the price of copper, if the price of copper shall exceed, for a period of fifteen days, the price of 12c. a pound, Valley delivery, the curtailment shall cease, no matter what existing stocks may be.

Should the total stocks of copper above ground not have been reduced by Dec. 31, 1932, so as to equal in the aggregate the total of the deliveries in the preceding four months, any company may without criticism nevertheless resume operations as it sees fit on thirty days' notice.

The new Rhodesian production, and several Canadian and South American mines not heretofore members, are expected to join Copper Exporters, Inc., on condition of the modification of certain of its rules, which have been agreed upon in principle. The drafting of these rules will require an appreciable length of time, and when formally adopted will be promptly filed with the Federal Trade Commission.

■

Copper Producers in Long Struggle Over Quotas

The series of copper conferences, held over a period of two full months, will probably go down in history as the most trying conflict of opinions ever waged by copper producers, owing largely to the wider distribution of low-cost production.

Undoubtedly the real obstacle to an early agreement among copper producers was the refusal of the representatives of Katanga to come to an understanding during the first three weeks of the period on the subject of maximum production rating. The stubborn fight waged by the Belgians was traceable in no small part, according to some observers, to the apparent eagerness of certain American groups to come to a settlement of the difficult problem at almost any cost. Others were not so ready to give in to the claims of the Belgians, particularly the representatives of Rhokana and Rio Tinto. At best, the curtailment plan

as presented late in November was viewed as a "patched-up job," satisfactory to virtually no one in the industry.

The main objective of the conference was to get world production of copper down to less than 90,000 tons a month. World production in recent months averaged about 120,000 tons a month; consumption is estimated at less than 100,000 tons. The producers that took part in the conference were virtually unanimous that output by the "cartel" should be restricted to between 50,000 and 55,000 tons a month, and this, with outside production at about 33,000 tons, would bring the total output inside the 90,000 limit.

Producers were prepared to listen to numerous extravagant claims as to productive capacity, and the committee in charge of this vital question was well equipped to handle the subject. But when the Katanga representatives put in a claim for a rating of 504,000,000 lb. annually, a figure no doubt based on capacity production using the very highest grade of ore on the property, opposition waxed strong. Some of the delegates held to the opinion that a fair rating for Katanga would be not more than 400,000,000 lb. a year. The Belgians, according to copper authorities, finally conceded to a rating, under the proposed plan, of 432,000,000 lb. The capacity rating took copper costs into account, and metal produced at excessive costs under present market conditions was not considered in the calculations.

Not satisfied with a curtailed output of about 115,000,000 lb. a year, Katanga submitted a plan whereby actual production of copper at its property be increased by about 60,000,000 lb. over that figure, but the company proposed to store this surplus until conditions in the industry improve. Stored copper, it was argued by opponents of this idea, is copper hanging over the market, and experience has proved that this is not good practice. Then, in a final attempt to arrive at a solution, it was proposed that independent engineers be appointed to investigate the Katanga property; and, if it be ascertained that the claims of the Belgians are justified, the production quota for Katanga could be adjusted later. This was acceptable to the Belgians but only on the understanding that all producers submit to a similar impartial investigation. Against this contention, it was held that an investigation so broad in scope might take years to complete, and what the industry needed most was immediate relief.

At this point, on Nov. 17, representatives of Katanga refused to proceed with the meetings and sailed for home. This was accepted as virtually the end of the copper negotiations. The one hope left was that the Belgians might reconsider their stand.

The Belgians, it was said in copper circles, were well acquainted with the tariff possibilities, both here and in England, and they would certainly not welcome what to all appearances would result in a sharp trade conflict for the European market. Domestic producers without foreign affiliations were prepared to push the tariff fight to the limit.

Phelps Dodge, one of the leading United States producers, announced on Nov. 25 that the company and affiliates would resign from Copper Exporters, Inc., the resignation to be effective in 30 days, the time required by the rules of that organization for action on such an important step. The very next day Katanga announced that the proposals with regard to curtailment would be acceptable, and negotiations were resumed. The Belgian and British delegations continued the meetings in London; the Americans in New York.

On Dec. 17, as it became evident that the negotiations were fast coming to a satisfactory conclusion, Phelps Dodge announced that it had decided not to resign from Copper Exporters, Inc.

Modification of the export marketing rules was achieved after another period of lengthy and heated discussion. Close observers of the copper situation believe that the foreign marketing problems have been straightened out. Under the revised rules, according to unofficial reports, all copper—fire-refined and electrolytic—will be grouped in the quotas established by Copper Exporters, Inc.

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United States Tariff Commission Reports Findings on Copper Costs

Pointing out that the domestic production of copper in the United States, after averaging about 48 per cent of the world's total in the five years preceding 1930, dropped to 40 per cent of the world production in 1930, the Tariff Commission on Dec. 22 announced its findings in an investigation of foreign and domestic production costs of copper. The investigation was made in response to Senate Resolution 434, of the 71st Congress.

"The fact that American capital controls a number of the most important foreign properties, thus assuring a further source of raw materials, contributes largely to the economic importance of the domestic refining and manufacturing industry," the Commission stated.

Most of the copper imported into the United States arrives in the form of "blister," the Commission explained. The blister was said by the Commission to be refined in domestic plants and to enter into competition with domestic refined copper or into the United States exports of refined copper.

"The greater part of the domestic copper industry," the Commission reports, "is under the control of three groups of financial interests, each of which operates on the principles of vertical and horizontal integration, controlling mines, concentrators, smelters, and refineries. There is, however, a considerable production of non-metallic copper-bearing minerals, as well as of smeltery products and refined metal by a number of smaller concerns."

The average value of the world's annual supply of copper was said by the Commission to be about $340,000,000, approximately one-half of which, until recent years, was obtained from the United States.

Before this country entered the World War, the exports of copper from the United States exceeded the imports by approximately 200,000 short tons. From 1918 to 1928, this excess was substantially smaller in relation to production and in absolute quantity than before the war. But during 1929 and 1930, "not only did this excess disappear, but a deficit occurred," the Commission asserted.

The Commission declared that "ten properties" supply about 70 per cent of the foreign copper mining industry's total annual output of about 1,200,000 short tons of copper.

The Commission's conclusions derived from its investigation follow in full text:

"The investigation herein reported shows that the largest item in the importation of copper into the United States is blister. The cost comparison between refined copper produced in the United States from domestic ores and blister copper produced in foreign countries plus the cost of refining such blister in the United States shows for 1928, the most representative year among the three years covered by the investigation, an excess of average domestic costs over costs for all the foreign countries covered by the investigation amounting to 1.42c. per pound when depletion of ore and interest on investment are taken into consideration, and 0.49c. per pound when these two items are excluded.

"Comparison with the lowest cost foreign region (Latin America exclusive of northern Mexico, together with Spain) shows an excess of domestic over foreign costs is 1.54c. when depletion and interest are included and 2.26c. without these items.

"If in addition to the foreign refined copper produced as blister and refined in the United States there should be added the copper refined in foreign countries, together with the cost of transporting it to the United States, the excess of domestic over foreign costs in the comparison with all foreign countries combined would be increased by about ½c. per pound when depletion and interest are taken into considera-

tion. The excess of domestic costs over those for Latin America and Spain would be increased still more by this procedure.

"On the other hand it should be noted that in computing both domestic and foreign costs, interest on investment has been calculated at 6 per cent. The question has been raised whether the risks of an enterprise in certain foreign countries would justify a higher rate of interest. If a higher rate of interest were allowed, the excess of domestic costs would be slightly reduced.

"The above cost comparisons relate to 1928. The cost estimates made by engineers with respect to copper now being produced (1931), or expected shortly to be produced in Africa, would tend to reduce the average foreign costs. It is impossible, however, to estimate with any precision the future cost of production in Africa."

■

Lead Production Down—Stocks Up in November

Total production of refined lead in the United States during November registered a decline of 5,777 tons, contrasted with the October figure, but stocks again increased on reduced shipments to consumers. The stocks at refineries at the end of November amounted to 144,057 tons, against 139,796 tons a month previous, and 132,804 tons on the last day of September, according to the American Bureau of Metal Statistics. Stocks of lead a year ago totaled 90,402 tons.

Output of lead from domestic ore held very close to the low point for the year, the total of 31,671 tons for November comparing with 36,546 tons in October. The monthly low for the current year was 30,708 tons in June. Daily rate of production for November was 1,056 tons, against 1,179 tons in the preceding month. Daily rate of production on domestic ore for November of last year was 1,447 tons.

Cable makers and consumers in the unclassified division took almost as much lead in November as in the preceding month, but shipments to battery and ammunition manufacturers fell off. Total shipments reported for the month were 31,216 tons, a new low since the beginning of the depression.

Lead refinery statistics for October and November, in tons, follow:

U. S. Lead Refinery Statistics (a)

Production:	October	November
Domestic ore	36,546	31,671
Secondary and foreign	4,722	3,820
Totals	41,268	35,491
Stock at beginning (b)	132,804	139,796
Total supply	174,072	175,287
Stock at end (b)	139,796	144,057
Shipments by difference	34,276	31,230
Shipments reported	34,276	31,216

(a) Accounts for refineries at Omaha, Selby, Perth Amboy, Carteret, Collinsville, East Chicago, Herculaneum, Grasselli, Federal, Galena, Newark, Matawan, Joplin and Ontario. (b) Does not include stocks of refined lead produced from ore or base bullion of foreign origin.

St. Joe Estimates Earnings in 1931; Cuts Dividend

St. Joseph Lead, largest lead producer in the United States, has estimated its 1931 earnings (on the basis of the first eleven months of the year) at $1,992,000, before deduction of interest charges, depreciation, or depletion. When these charges are included, the 1931 deficit will be about $1,400,000. As a result, the company's directors have reduced the dividend to 15c. for the March quarter, compared with the rate of 25c. quarterly now being paid. In former years, the company decided on its dividend policy for an entire year at one time, but the directors have now decided to follow the more conservative policy of acting on each quarter's dividend separately.

At the end of this year, St. Joe expects to be holding 64,900 tons of pig lead, an increase of 25,100 tons over the stock at the beginning of the year. This figure is equal to about one-third of the company's normal annual production. At present, production rate is probably not more than 120,000 tons of lead annually. The company reports that on Nov. 30, current assets totaled $13,697,647 and current liabilities were $2,071,090.

■

World's Silver Output Continues to Decline

World production of silver continues on a level well below that established last year, based on figures released by the American Bureau of Metal Statistics. The reduced supply is traceable to the fall in the production of base metals, as output of byproduct silver has been far greater than that produced by mines in the precious-metals group.

Production of silver in the United States during November totaled 2,012,000 oz., against 2,181,000 oz. in October, and 3,738,000 oz. in November, 1930. The monthly average production in the United States for the first eleven months of the current year was 2,646,000 oz., against a monthly average of 4,186,000 oz. for the whole of 1930. United States production for the January-November period totaled 29,110,000 oz., against 46,521,000 oz. in the same period last year.

Canadian production for November was 1,659,000 oz., against 2,117,000 oz. in the preceding month. Canadian production for the first eleven months of the current year amounted to 17,763,000 oz., against 21,404,000 oz. in the same period last year.

Production of silver in Peru, Australia, and Burma has shown little variation in recent months though output in each of those countries has been on a somewhat lower plane than at this time last year.

Silver statistics for Mexico, the leading producer, are not yet available beyond September. September production in Mexico totaled 7,510,000 oz., against 6,814,000 oz. in August, and 9,154,000 oz. in September last year. During the first nine months of this year Mexico produced 66,869,000 oz. of silver, against 79,112,000 oz. in the same period last year.

World production (approximately 87 per cent of world's output) for the month of September amounted to 12,490,000 oz., against 12,643,000 oz. in August, and 19,118,000 in September, 1930. World production during the first nine months was 125,005,000 oz., against 161,871,000 oz. in the same period last year.

■

Idaho-Maryland Shows Profit

Idaho-Maryland, gold producer, at Grass Valley, Calif., earned net operating profit of $240,010 during the 22 months ended Oct. 31, 1931, it being made principally during 1931, as a small loss resulted in 1930. For the current year 45,005 tons of gold ore was milled. Gross recovery was $574,573, or $12.77 per ton. Expenditures in 1930 were $236,686, and the total for the ten months of 1931 was $327,493. Outstanding indebtedness has been paid and sufficient profit is being made to retire within a short time the 220,966 shares of preferred stock outstanding.

Silver Production

Output of silver for 1931, December excepted, by important producing countries, according to the records of the American Bureau of Metal Statistics, all figures in thousands of ounces, follows:

	United States	Canada	Mexico	Peru	Australia	Burma
January	3,480	1,932	8,751	918	695	540
February	3,187	1,772	6,944	1,047	657	530
March	3,528	1,431	6,510	1,056	689	530
April	2,831	1,139	9,535	1,215	683	530
May	2,762	1,836	7,374	1,389	638	470
June	2,433	731	7,041	1,145	558	510
July	2,176	2,133	6,390	1,063	633	460
August	2,419	1,610	6,814	795	545	460
September	2,101	1,403	7,510	562	454	460
October	2,181	2,117	(a)	609	433	470
November	2,012	1,659	(a)	578	561	(a)
Totals	29,110	17,763	(b) 66,869	10,377	6,546	(c) 4,960
Monthly Averages						
1929	5,015	1,799	9,058	1,791	747	607
1930	4,186	1,954	8,767	1,386	738	588
1931	2,646	1,615	(b) 7,430	943	595	(c) 496

(a) Not yet available. (b) Nine months. (c) Ten months.

International Tin Pool Raises Release Price

All signatory governments to the international tin quota agreement have approved a revision of the sliding scale of prices originally fixed for release of the pool's holding of tin. The revision provides that the present minimum price of £150 a ton shall be increased to £165 and this will now be the minimum price at which the initial amount of 5 per cent of the pool's holding may be released for sale, if and when this shall have been the average price of spot tin on the London Metal Exchange during any completed calendar month. The next successive price limit, at which 10 per cent may be released, has been similarly increased to £176, and the further release prices have been adjusted accordingly.

The committee ascertained that the pool now holds 19,000 tons of tin metal. All of this appears in visible supplies.

■

Alaska Gold Production Up

Shipments of gold in ore, base bullion, and gold bullion from Alaska contained $7,366,025 in gold in the first ten months of 1931, according to reports of the U. S. Department of Commerce. In October shipments were $1,558,640, the highest during the year. As 1930 total output was $8,420,800, a considerable increase is indicated for the current year, particularly since shipments in the last few months of the year are always heavier than at other times, because dredges are making clean-ups preparatory to closing down in December or January. Of the shipments in the first ten months, $1,193,394 was contained in ore and base bullion, and $5,932,262 was contained in gold bullion shipped to the United States. To foreign countries, shipments totaled $35,870 in ore and $179,725 in gold bullion during the first ten months of 1931.

■

Financial Notes

GRANBY CONSOLIDATED, copper producer of British Columbia, reports a profit of $52,183 in the third quarter of 1931, after crediting miscellaneous income but before deducting depreciation or depletion charges. Operations showed an operating deficit of $5,697. In the corresponding quarter of 1930, profit before depreciation or depletion was $172,017.

CALAVERAS CENTRAL GOLD MINING, operating a drift property in California, has been granted permission to sell 125,000 shares at $1 a share for development purposes.

SUNSHINE MINING, silver producer of Idaho, has declared a dividend of 2c. a share, payable Dec. 21. This is the first dividend the company has paid this year, although in the four years 1927-1930 a total of $870,000 was disbursed, or 58c. a share. Even with present low prices for silver, production is being maintained at 500 tons of ore daily.

■

K.L.G. May Pay Dividends

J. B. Tyrrell, president of Kirkland Lake Gold Mines, one of the smaller producers at Kirkland Lake, Ont., has stated that if the company continues to develop ore at the present rate and the grade holds up to expectations the board will consider starting to pay dividends early in the new year. By the end of 1931 the company expects to have a cash surplus of $450,000. During 1930 net liquid assets increased from $70,865 to $207,000; during the first eleven months of this year production amounted to $588,000, and at the end of the year net liquid assets will increase to $450,000, with prospects for 1932 that there will be still further improvement.

■

Lead Investigation Dismissed

The Tariff Commission has announced that in accordance with Senate Resolution No. 88, adopted Dec. 14, 1931, the investigation heretofore instituted to ascertain the differences in costs of production of lead pursuant to Senate Resolution No. 441 of the Seventy-first Congress has been discontinued and dismissed without prejudice. This investigation was instituted under the provisions of Section 332 of the Tariff Act of 1930, and the report of the results of the investigation was to have been made to the Senate.

Senator King, who introduced the original resolution, offered the resolution to rescind the order for investigation.

■

Mayflower Pays Dividend

In letter to stockholders accompanying the Dec. 15 dividend check, Robert E. McConnell, president of Mayflower Associates, Inc., mining finance company, states:

"As of Dec. 1 the net earnings and earned surplus of the company were $348,386 before deducting a realized loss of $1,768,452 from sale of securities for the first eleven months. As this realized loss from sale of securities thus exceeds by $1,420,066 the total net earnings and the earned surplus of the company, the Dec. 15 distribution consequently is made from capital surplus. The value of all securities in inventory, calculated from market quotations of Nov. 30, 1931, was $3,550,410 below cost prices."

Copper Up to 7¼c. on Curtailment News; Demand for Lead, Zinc Better

New York, Dec. 24, 1931.—Announcement on Dec. 22 of a new plan for curtailing world copper production to prevent further increases in stocks of the metal was the outstanding feature of the non-ferrous metal markets in the last two weeks. The announcement had been anticipated by several days, the price of copper having reached 7¼c. a pound, delivered Connecticut basis, late on Dec. 17. Lead demand improved somewhat after the price was cut to 3.75c. a pound, New York. Interest has been stimulated largely by the recent price reduction. Zinc gained fractionally to 3.15c. a pound, East St. Louis, at which point it has remained comparatively stable. Silver, after rising from 29⅛c. an ounce to 31⅝c., lost most of its gain, closing at 29⅝c.

Copper Rises 1c. From Low

On Dec. 12 and 14, small lots of copper were sold at 6¼c. a pound, Connecticut basis, equaling the all-time low. However, the market firmed perceptibly as reports that a new agreement with regard to production had been reached. On Dec. 15, good business was done at 6½c. a pound and the following day most of the custom smelters, as well as the large producers, were asking 6¾c. Actual transactions, however, were all at the 6½c. basis. On Dec. 17, the price opened at 6¾c. in the morning and reached 7¼c. by evening. Thereafter, demand quieted down and in spite of the fact that the actual announcement of production plans was made on Dec. 22, no further increase in the price occurred. A good tonnage was sold during the calendar week ended Dec. 19. At present, the market seems to have fallen into its usual holiday calm, much to the disappointment of producers who would like to see the price advance before the year end so as to establish a better inventory position. Without substantial demand from consumers, however, such an increase is not likely.

Foreign business for the month to date has been fairly good, the total being about 27,000 tons. Inquiry from France, Italy, Belgium, and Scandinavia has been surprisingly good; England and Germany have taken little, however. The new marketing plans of the Copper Exporters' organization have not quite been completed, although all members are in substantial agreement on the main points. Fire-refined copper will be taken out of the non-participating class and foreign consumers will be able to purchase copper freely at a differential of not more than a quarter of a cent above the domestic market. These moves are expected to satisfy foreign consumers who have complained of

rationing of sales. No official announcement is expected with regard to marketing changes, but the plan will take effect early in 1932.

Lead Steady at New Level

A. S. & R. reduced its New York contract price on lead 10 points to 3.75c. a pound on Dec. 14, since when the metal has been steady at that level. In the St. Louis market a corresponding reduction was made to maintain the 20-point differential between the two markets. As December requirements had already been well covered, sellers did not anticipate any marked improvement in demand at the new price. Sales during the *E.&M.J.* week ended Dec. 23, however, totaled about 4,500 tons, considered excellent under present conditions. Consumers are inclined to consider lead a good buy at its present level—which equals the low established in June and again in October. More than 17,000 tons already have been sold for January shipment. Sales for December shipment will be about 36,000 tons, the latest figures indicate. The statistical position of the industry was enhanced by the November figures, which showed another cut in production.

Tin Improves with Sterling

Improvement in sterling exchange has been the chief cause for the steady rise in New York quotations on tin, as demand for the metal has been quiet. Reassuring reports from abroad on the status of the international tin pool and the curtailment agreement have helped to encourage the rise. The metal closed on Dec. 23 about 1½c. higher than the low for the movement of 20.60c. established early in the month.

Zinc Slightly Higher

The zinc market has been dull and steady around 3.15c. throughout the two weeks covered by this review. Some improvement in demand was noted toward the end of the period. Metal is being sold for delivery throughout the first quarter, and some sellers have been able to obtain 3.175c. and 3.20c. for February or March delivery. Closing of the Evans-Wallower plant, in East St. Louis, takes a small tonnage off the High-Grade market, which continues at a premium of about 1c. over Prime Western brands.

Silver Wobbles

With silver production showing a real drop, hope for genuine improvement in silver prices manifested itself in speculative interest that carried the quotation up to 31⅜c. an ounce on Dec. 16. The abandonment of the gold standard of Japan was another factor in the market. More recently interest has slackened, probably because of the impending holiday season, and the price has fallen back.

Sterling Exchange, 90-Day

Sterling Exchange, 90-day demand, December 10th, $3.29¾; 11th, $3.30½; 12th, $3.38¼; 14th, $3.40½; 15th, $3.43½; 16th, $3.43¾; 17th, $3.44; 18th; $3.33¼; 19th, $3.38½; 21st, $3.38¼; 22d, $3.39; 23d, $3.41¼.

Zinc and Lead Concentrates

The Joplin, Mo., market for zinc concentrate settled at $18 per ton for Prime, base 60 per cent. Lead, basis 80 per cent, closed at $37.50@$40 per ton.

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices, and at present are largely nominal in view of erratic sterling exchange.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 and 98 per cent, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 23.30c.; 98@99 per cent, 22.90c. London, £95, less 2 per cent, per long ton, for 98 per cent ingots and bars.

ANTIMONY — Per lb., duty paid, Chinese, spot, 6.25c.; futures, 6c. Cookson's "C" grade, spot, 11½c. "CMC" grade, 99.9 per cent, spot, 11c.

BERYLLIUM—See Alloys.

BISMUTH—Per lb., in ton lots, $1.15. London, 6s. 4d., nominal.

CADMIUM—Per lb., 55c. London, 2s. 2d.@2s. 3d. Nominal.

CHROMIUM—Per lb., 97@98 per cent grade, 85@90c. per lb. contained chromium, maximum 1 or 2 per cent iron. (Usually sold as ferrochrome.)

COBALT—Per lb.: Metal imported from Belgium, 97@99 per cent, $2.50 less 35 per cent for cash. On yearly requirements, usual rebate of 5 to 10 per cent, as to quantity. London quotes $3.75 per kilo, subject to usual discounts.

INDIUM—Per oz., 98½ per cent, $90@$100 per oz. Nominal.

IRIDIUM—Per oz., $90@$100 for 98@99 per cent sponge and powder. London, £22@£24. Nominal.

LITHIUM—Per lb., 98@99 per cent, 100-lb. lots, $15.

MAGNESIUM—Per lb., ingots (4x16 in.), 99½ per cent, 30c. in carloads; 32c. in 100 lb. lots or more, l.c.l.; ⅜, ½, 1, and 2 lb. sticks, 5c. per lb. over ingot price; ⅛ and ¼ lb. sticks, 8c. per lb. extra.

MANGANESE—Per lb., 95@97 per cent, 42c. (Usually sold as ferromanganese.)

MOLYBDENUM—Per lb., in 10- to 50-lb. lots, C.P. powder, $9; 97 per cent, $4.50. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb. electrolytic cathodes, 35c.; shot and ingot made from remelted electro, 36c. for single lots of spot metal. London, per long ton, £225 to £230, with prices nominal.

OSMIUM—Per oz., $65@$70. London, £15 10s. to £16.

PALLADIUM—Per oz., $19@$21. London, £4 10s., nominal.

PLATINUM—Per oz. Official price of leading interest, $40. Cash transactions between dealers and refiners several dollars less. London market nominal at £10 2s. 6d. to £10 8s. 6d.

QUICKSILVER — Per 76-lb. flask, $65@$66. Demand was slow and prices showed further weakness. The low prices are discouraging production in some quarters.

RADIUM—Per mg. radium content, $50 in lots of 4 grams or more, to $65 for 1 gram; smaller quantities, $70.

RHODIUM—Per oz., $55.

RUTHENIUM — Per oz., $50@$55.

SELENIUM—Per lb., $1.80@$2, depending on quantity, for black, powdered, 99.5 per cent pure.

SILICON—Per lb., minimum 97 per cent Si, maximum 1 per cent Fe, 15@17c.

TANTALUM—Per kilo, $91 for C.P. bar or sheet.

TELLURIUM—Per lb., $2.

THALLIUM—Per lb., $12.50@$15.

TITANIUM—Per lb. in 50- to 100-lb. lots, 75 per cent, $5.

TUNGSTEN—Per lb., contained tungsten, 98 per cent, powdered, $1.45.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

ANTIMONY ORE—No sales reported. London, per long ton unit, 4s. for 60 to 65 per cent sulphide ore.

BERYLLIUM ORE—Per ton, minimum 10 per cent BeO, $20@$30, f.o.b. mines.

CHROME ORE—Per long ton, c.i.f. Atlantic ports, Indian ores, $17.50 for 46@48 per cent Cr_2O_3 ore, and $19.50@$20 for 50@51 per cent ore. London, 80s. for 48 per cent Rhodesian.

COBALT ORE—Per lb. of Co, 12 to 14 per cent grade, 50c., f.o.b. cars, Ontario. Market nominal.

IRON ORE—Per long ton, Lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per long ton unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per long ton unit:

North African and Swedish, low-phosphorus, 8½@9½c.

Daily Prices of Metals

Dec.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
10	6.275	20.60	3.85	3.65	3.15
11	6.275	20.65	3.85	3.65	3.15
12	6.025@6.275	21.35	3.85	3.65	3.15
14	6.025@6.275	21.55	3.75	3.55	3.15
15	6.275	21.40	3.75	3.55	3.15
16	6.275	21.60	3.75	3.55	3.15
Av'ge	6.233	21.192	3.800	3.600	3.150
17	6.575	21.625	3.75	3.55	3.15
18	6.65	21.125	3.75	3.55	3.15
19	7.025	21.625	3.75	3.55	3.15
21	7.025	21.70	3.75	3.55	3.15
22	7.025	21.875	3.75	3.55	3.15@3.20
23	7.025	21.95	3.75	3.55	3.15
Av'ge	6.888	21.650	3.750	3.550	3.154

Average prices for calendar week ended December 12, 1931, are: Copper, 6.254c.; Straits Tin, 20.727c.; New York Lead, 3.850c.; St. Louis Lead, 3.650c.; Zinc, 3.156c.; Silver, 29.708c.

Average prices for calendar week ended December 19, 1931, are: Copper, 6.492c.; Straits Tin, 21.488c.; New York Lead, 3.750c.; St. Louis Lead, 3.550c.; Zinc, 3.150c.; Silver, 31.146c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold, London	Dec.	Sterling Exchange "Checks"	Silver		Gold, London
		New York	London				New York	London	
10	$3.29 3/4	29 5/8	20 3/16	125s 3d	17	$3.44 1/2	31 5/8	20 7/16	119s 6d
11	3.30 1/2	30 1/4	20 7/16	125s ..	18	3.33 3/4	30 3/4	20 3/8	122s 2d
12	3.39	29 3/4	20 1/16	.....	19	3.39	31	20 7/16	.....
14	3.41 1/2	30 5/8	19 13/16	118s 9d	21	3.38 1/2	30 3/4	20 7/16	122s 1d
15	3.43 1/2	31 1/4	19 7/8	119s 1d	22	3.39 1/2	30 5/8	20 5/16	121s10d
16	3.44 1/4	31 5/8	20 1/4	119s 7d	23	3.41 1/4	30 5/8	19 15/16	120s 7d

Average for week ended December 16th: Silver, 30.500c.; Sterling exchange, $3.38083.
Average for week ended December 23rd: Silver, 30.896c.; Sterling exchange, $3.39417.

New York quotations are as reported by Handy & Herman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables commanded one-half cent premium at noon on Dec. 22.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic (Bid)						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
10	37 1/2	38 1/8	43	136 3/4	139 3/4	15	15 1/16	14 1/16	14 9/16
11	37 1/2	38 1/8	44	137	140	14 15/16	15 3/16	14 3/16	14 11/16
14	36 3/4	37 5/16	43 1/2	136 7/8	139 7/8	14 13/16	15 1/16	14	14 1/2
15	36 11/16	37 5/16	43	136 3/8	139 3/8	14 13/16	15 1/16	14	14 1/2
16	37 1/8	38 1/16	43	138 1/8	141 1/8	14 7/8	15 1/8	14 1/8	14 5/8
17	38 15/16	39 9/16	43 1/2	138 1/2	141 3/8	15	15 1/4	14 5/16	14 13/16
18	41 1/4	41 1/2	47 1/2	138 7/8	142	15	15 1/4	14 7/16	14 15/16
21	40 1/2	40 3/4	47	141	144	15 5/16	15 9/16	14 3/4	15 3/16
22	40 7/16	41 1/8	47	141 7/8	144 7/8	15 3/8	15 1/2	14 11/16	15 1/8
23	38 9/16	39 1/4	46	141 5/8	144 3/4	15 1/4	15 1/2	14 9/16	14 15/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Spanish and North African, basic, 50@60 per cent, 8½@9c.

Swedish foundry or basic, 65@68 per cent, 9c.

Newfoundland foundry, 55 per cent iron, 8½c. Nominal.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty: Brazilian, 46@48 per cent Mn, 23c.; Chilean, 47 per cent minimum, 29c.; Indian, 48@50 per cent, 25@26c.; Caucasian, 52@55 per cent, 26c.; South African, 52@54 per cent, 23@25c.; 50 to 52 per cent, 22@24c.; 44 to 46 per cent, 21½c.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $50 in carloads, to $60 barreled. Javan or Caucasian, 85 per cent minimum, $50@$60. Domestic, 70 to 72 per cent, $43@$50 in carloads, f.o.b. mines.

MOLYBDENUM ORE—Per lb. of contained MoS_2, nominally 45c., delivered Pittsburgh, for 75@85 per cent concentrate. London, per long ton unit, nominal at 37s. 6d. to 42s. 6d. for 80@85 per cent concentrate.

TANTALUM ORE—Per lb., Ta_2O_5, 70c. for 60 per cent ore. Market nominal.

TIN ORE — No market in United States. London market wholly nominal owing to exchange situation.

TITANIUM ORE — Per gross ton, ilmenite, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Chinese wolframite, $11, duty paid. Bolivian scheelite, $10.90. Domestic, $10.50@$11.50.

VANADIUM ORE—Per lb. V_2O_5 contained, 27c., f.o.b. shipping point. London, prices withdrawn temporarily.

ZIRCON ORE—Per ton, 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots. Crude granular zircon, $70, f.o.b. Suspension Bridge, N. Y.; milled, $90.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and and seller.

Tons of 2,000 lb. unless otherwise noted.

AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent Li_2O, $50@$60.

ASBESTOS — Per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $400; crude No. 2, $200; spinning fibers, $100@$125; magnesia and com-

pressed sheet fibers, $100@$125; various grades shingle stock, $50@$65; various grades paper stock, $27.50@$35; cement stock, $15@$20; floats, $10@$15.

Per ton c.i.f. New York: Rhodesian crude No. 1, $300; No. 2, $200. Nominal.

Per ton, c.i.f. New York: Russian crude No. 1, $225; No. 2, $175; No. 3, $125. Nominal.

Per ton, f.o.b. mines, Vermont: Shingle stock, $45; paper stock, $35; cement stock, $20.

BARIUM CARBONATE (Witherite) — Per ton, 90 per cent 300 mesh, $42; 100 mesh, $39.

BARYTES—F.o.b. mines:

California: Crude, $7 per ton.

Georgia: Barytes ore, crude, $6@$6.50 per long ton.

Missouri: Per ton, water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, minimum 95 per cent $BaSO_4$, less than 1 per cent iron, $6; 1 per cent iron and 93 per cent $BaSO_4$, $5.50, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $6.50@$8, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6@$7.50, f.o.b. *Arkansas* mines. Pulverized and dried, 56 to 59 per cent Al_2O_3, 8 to 12 per cent SiO_2, $10@$12.25, f.o.b. *Arkansas* mines; abrasive grade, crushed and calcined, 78 to 84 per cent Al_2O_3, $14@$16, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic ports: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6. Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$6.50; French, 56 to 59 per cent Al_2O_3, 2 to 4 per cent SiO_2, $5.50@$7.

BENTONITE—Per ton, carload lots, f.o.b. *Wyoming* mines, dried and crushed, in bulk, $8; in bags, $10. F.o.b. Chicago, selected air-floated, $25.

BORAX — Per ton, carload lots, in bags, crystals, $56; granulated, $50; powdered, $57.50; f.o.b. shipping point.

'CELESTITE—Per ton in carload lots, 90 per cent $SrSO_4$, finely powdered, $27.

CHINA CLAY (KAOLIN)—Per ton, f.o.b. *South Carolina* mines, crude lump, No. 1, $5@$6; crushed, $7; pulverized, $9@$15.

Florida, washed and crushed, No. 1, $12.50; No. 2, $12.

Delaware, No. 1, $14.50.

Imported English, f.o.b. American ports: lump, $17@$21 in bulk.

DIATOMITE—Per ton, f.o.b. *Nevada,* crude, dried, in bags, $10; minus 40 mesh, $15; 300 mesh, $20; high temperature insulation, $30.

EMERY—Per ton, f.o.b. *New York,* domestic crude ore, first grade, $10. Other American ore, delivered to grinders, per gross ton, $15; Turkish and Naxos ore, $30@$35. F.o.b. *Pennsylvania,* in 350-lb. kegs, Turkish, Khasia, and Naxos grain emery, 6½c. per lb.; American, 3½c.

FELDSPAR — Per ton, f.o.b. *North Carolina,* potash feldspar, 200 mesh, white, $15, in bulk; soda feldspar, $18. F.o.b. *Maine,* potash feldspar, white, 200 mesh, $19, in bulk. Granular glasspar, white, 20 mesh, f.o.b. *North Carolina,* $10.50 in bulk.

Virginia, No. 1, 325 mesh, $17; 200 mesh, $15@$16; 160 mesh, $14@$15; No. 1 glassmakers', $11; enamelers', $12.50.

New Mexico: Crude clean No. 1 potash spar, $4.75; ground, $9.50.

FLUORSPAR — Per ton, f.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, bulk basis, $13. Foundry lump, 85-5, $15@$17. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $30 in bulk; $34 in bags or barrels. *Colorado* mines, 82-5, $10.

Foreign fluorspar, gravel, 85-5, $18.50 per gross ton, duty paid.

FULLER'S EARTH — Per ton, f.o.b. *Colorado,* $18, various finenesses to minus 90 mesh.

F.o.b. *Georgia* or *Florida,* 30 to 60 mesh, $16; 15 to 30, $15; 200 up, $10; 100 up, $7.

GARNET—Per ton, f.o.b. *New Hampshire* mines; concentrate, $40; washed grades, $125.

New York: Adirondack garnet concentrates, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. *Colorado:*

Brilliant black, $32.90; seconds (mine run), $25.50.

Selects, $30.50, f.o.b. Utah. Nominal.

GRAPHITE—Per lb., f.o.b. *New York:* Ceylon lump, 6½@7½c.; carbon lump, 3@6c.; chip, 5@6c.; dust, 3@4c.; Madagascar flake, 5@6c.

No. 1 flake, 8@16c.; No. 2, 5½c. upward; fine ground, 55 to 70 per cent carbon, 3c. upward; amorphous, 3c. upward.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20.

GYPSUM—Per ton, f.o.b. mill, crushed rock, *Iowa,* $2.50; *Ohio* and *New York,* $3. Ground, *Ohio,* $4; *Iowa,* $6. Agricultural, $6@$7. Calcined, $6@$9.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

KIESELGUHR—See Diatomite.

LEPIDOLITE—Per ton, $50@$60 for ordinary grades. Nominal.

LIMESTONE—Per ton, f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$1.75.

Agricultural, $1 up to $6 per ton, as to grade and point of shipment.

MAGNESITE—Per ton, f.o.b. *California,* dead-burned, $25. Kiln run, 93 per cent MgO (artificial periclase), $68; 88 per cent MgO, $35. Caustic, 95 per cent MgO, $45; 90 per cent, $40. *Washington:* Dead-burned grain magnesite, $22.

MICA—Per ton, f.o.b. *New Mexico,* scrap, white, $21; off color, $18. Punch, white, for disks, per lb., 10c.; for washers, 8c.

Per ton, f.o.b. *New Hampshire,* roofing mica, $23; snow, $34; 40 mesh white, $40; 60 mesh, $48; 100 mesh, $60; 200 mesh, $75. Clean dry mixed bench and mine scrap, $13.

Per lb., f.o.b. *North Carolina:* Punch, 3@5c.; 1½x2 in., 20@30c.; 2x2, 30@50c.; 2x3, 60@90c.; 3x3, $1@$1.40; 3x4, $1.40@$1.80; 3x5, $1.50@$2; 4x6, $2.25@$3; 6x8, $2.50@$3.75; 8x10, $5@$7.50. These prices apply both to No. 1 and No. 2 mica. Black-stained mica takes a discount of 10 to 25 per cent from this schedule. White North Carolina mica, 70 mesh, $60 to $80. Biotite, or black mica, $15 a ton, unground.

MINERAL BLACK—(Graphitic shale) —Per ton, 325 mesh, 75 per cent carbon. $22.50, f.o.b. *Virginia.*

MONAZITE—Per ton, minimum 6 per cent ThO_2, $60.

OCHER — Per ton, f.o.b. *Georgia* mines, $17.50 in sacks; $21 in barrels. Buff clay, 98 per cent through 325 mesh, $18.

F.o.b. *Virginia,* dark yellow, 300 mesh, 60 per cent ferric oxide, in jute bags, $19.50.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground lime phosphate, 80 per cent through 300 mesh, 33 per cent P_2O_5, $12.80 per net ton, bags extra.

PUMICE STONE—Per lb., in barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur, c.i.f. United States ports, guaranteed 48 per cent sulphur, Spanish, 13c.

POTASH—Per ton, contracts:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 48 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

Prices are delivered to Atlantic ports. Discounts up to 4 per cent for early shipment. Spot prices, $1.25@$1.50 per ton higher than on contract.

[1]QUARTZ ROCK CRYSTALS—For fusing, all sizes, $250 per ton. Prisms for piezo-electrical and optical use command premium.

SILICA—Per ton, water ground and floated, in bags, f.o.b. *Illinois:* 325 mesh, $16@$40 for 92 to 99½ per cent grades. Dry ground, air-floated, 325 mesh, 92@99½ per cent silica, $14@$30. Glass sand, f.o.b. producing plant, $1.25@$5 per ton; molding sand, 50c.@$3.50; blast sand, $1.75@$6. *California:* $5 for quartz and $2.50 for sand.

[1]STRONTIANITE — Per ton, lump in carload lots, minimum 90@92 per cent $SrCO_3$, $100.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC — Per ton, carload lots, f.o.b. works, containers included unless otherwise specified:

New Jersey: Soapstone, ground, $10@$12.

New York: Double air floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7@$7.50. Packing in paper bags, $1 per ton extra.

Virginia: 200 mesh, $4.60@$8.25; 325 mesh, $8.75@$10.50.

TRIPOLI — Per ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $15. Double ground through 110 mesh, rose and cream, $17. Air-floated through 200 mesh, rose and cream, $22.50.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. London, per long ton, £23 for Cornish white. Mexican, not quoted openly, owing to exchange situation.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 85c.

COBALT OXIDE—Per lb., black oxide, 70@71 per cent grade, $1.35.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 3.10c. for either large or small crystals.

SODIUM NITRATE—Per 100 lb., crude natural, in bags ex vessel, Atlantic ports, $1.77.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $16@$18.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

ZIRCONIUM DIOXIDE—Per lb. in 100- to 500-lb. lots, 87 per cent ZrO_2, commercial, 50c.

Refractories

CHROME BRICK—Per ton, f.o.b. shipping point, $45. Grecian refractory ore, 37@42 per cent, 40c. per unit.

FIRECLAY BRICK — Per M., first quality, $40, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35.

MAGNESITE — Brick, per ton, f.o.b. works, 9-in. straights, $65. Dead-burned grain, $40, f.o.b. Chester, Pa., or Baltimore.

SILICA BRICK—Per M., *Pennsylvania,* $40: *Alabama,* $50@$51; *Illinois* and *Indiana,* $49.

ZIRKITE—Per lb., powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Rolled Metals

COPPER — Per lb., sheets, hot-rolled, 16⅜c.; wire, f.o.b. mill, 9½c.

LEAD SHEETS—Per lb., full rolled, 7c.; clipped, 7¼c.

MONEL METAL—Per lb., sheets, full finished, 42c.; strip, cold-rolled, 45c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 12c.; sheets, 15⅜c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER — Per lb., sheets, 10 per cent, 21⅜@21¾c.; 18 per cent, 24⅞@25¼c. Wire and rods, 10 per cent, 24⅞c.; 15 per cent, 28⅞c.; 18 per cent, 32⅜c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 27⅛c.; wire, 5 per cent, 27⅝c.; 10 per cent, 32⅛c.

ZINC SHEETS—Per lb., 9c., f.o.b. works; ribbon, 8½c.; 7 per cent discount on orders for 18 tons or more.

Alloys

BERYLLIUM—Per lb. of contained Be, $50, chiefly sold as an alloy of 12 per cent Be and 88 per cent Cu.

FERROCHROME — Per lb. of contained chromium, 4 to 6 per cent carbon, 65 to 70 per cent chromium, 11c., delivered, on contracts; spot, 11½c. Containing 2 per cent carbon, 67 to 72 per cent chromium, spot, 17½c.; maximum 0.10 per cent carbon, 26c., spot; 24½c. contracts.

FERROMANGANESE — Per gross ton furnace: domestic and foreign, 78@82 per cent, $80@$85, contracts, depending on quantity. Spiegeleisen, 19@21 per cent, $30 for spot carloads.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.

FERROPHOSPHORUS—Per gross ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee.*

FERROSILICON — Per gross ton, delivered, 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $31, f.o.b. Niagara Falls, N. Y. Spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton, $150, f.o.b. producer's plant, carlots.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1@$1.10, f.o.b. works.

FERROVANADIUM—Per lb. of V contained, delivered, $3.15@$3.50.

SILICOMANGANESE — Per long ton, carload contracts, delivered, $105 for maximum 2½ per cent carbon; $115 for maximum 1 per cent carbon.

SILICON ZIRCONIUM—Per lb., 47@52 per cent Si, 35@40 per cent Zr, 18@21c.

ZIRCONIUM FERROSILICON—Per gross ton, 12@15 per cent Zr, 39@43 per cent Si, $103.50@$108.50.

Iron, Steel, and Coke

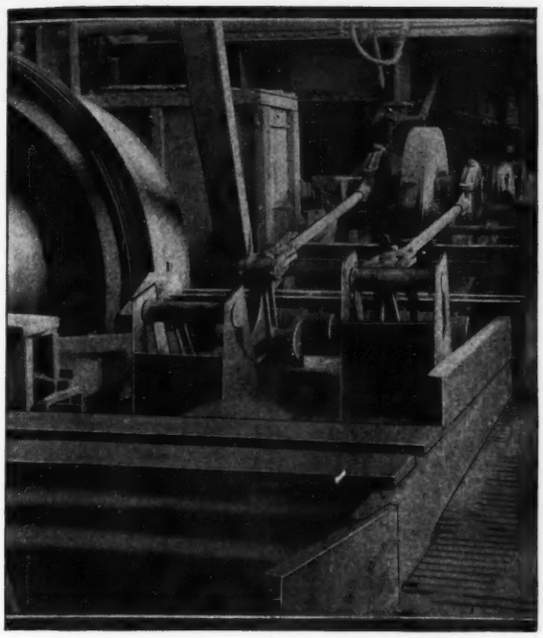
IRON—Per gross ton, Valley furnaces: Bessemer, $16@$16.50; basic, $15; and No. 2 foundry, $15.50@$16.

STEEL—Per gross ton, base prices, Pittsburgh, billets and slabs, $29; bars, plates, and structural shapes, per 100 lb., $1.50@$1.60.

COKE—Per ton, Connellsville furnace, $2.35@$2.40. Connellsville foundry, $3.25@$4.50. Birmingham furnace, $3.50@$4.50. Byproduct coke, Ohio and Kentucky (Connellsville basis), $5.50; Buffalo and Detroit, $8@$8.50; Birmingham foundry, $5.

[1]Price furnished by Foote Mineral Company, Philadelphia.

The DORR F CLASSIFIER WILL RAKE MORE SAND



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A better machine for closed-circuit grinding work

The continued trend toward even greater circulating loads in closed circuit grinding work was one of the factors underlying the development of the new F Classifier. The great sand raking capacity of the F enables it to handle extremely heavy circulating loads. Grinding capacity goes up, grinding costs go down.

This feature makes the F a particularly valuable unit in any mill where floor space is limited. Per unit of Classifier width, the F offers you maximum sand raking capacity. Thus you can step up to a marked degree the capacity of your classification units, without any increase in floor space requirements.

Our nearest office will be glad to send you full information on the F machine. Every mill man will be interested in this latest Dorr development in the field of classification.

DORRCO

Ask for Bulletin 2111

●

THE DORR COMPANY, INC.

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TOKYO: Andrews & George Co., Inc.

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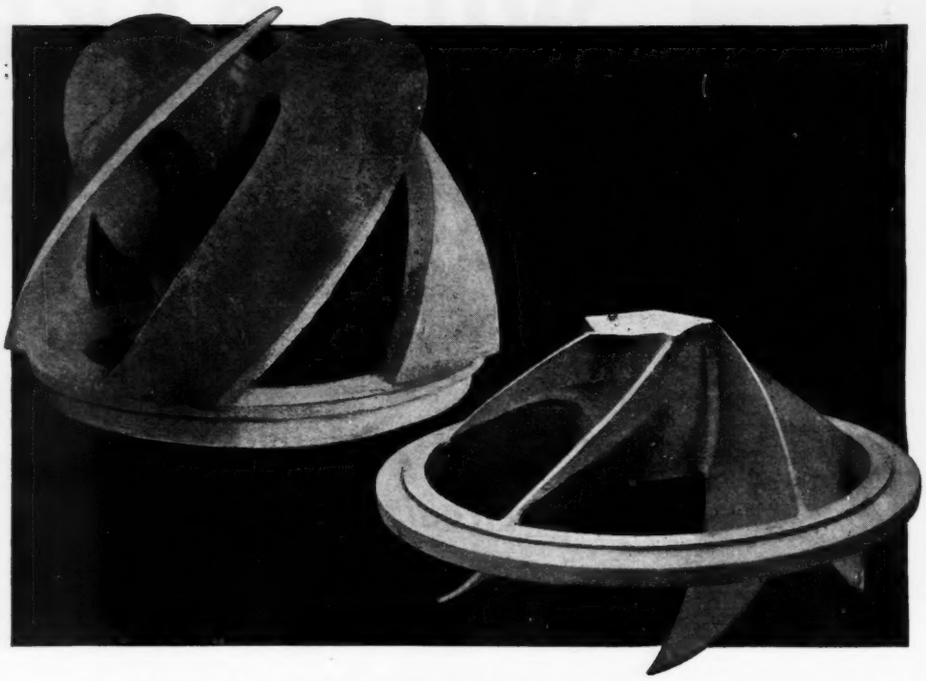
MIDVALOY



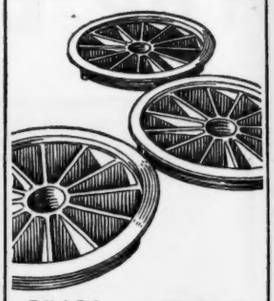
THE METAL OF A THOUSAND PROPERTIES
AND A THOUSAND USES—

Complexities in today's manufacturing processes; increasing use of metal parts under highly corrosive conditions, have necessitated an entirely new series of qualities in the metal parts used. Midvaloy has solved for many industries the need for a metal having both high strength and resistance to corrosion. On this page are but a few of the many forms in which Midvaloy leaves the Midvale plant.

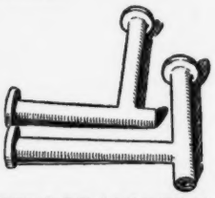
Midvale pioneered in heat resisting and corrosion resisting alloys. For 59 years Midvale has been both making and studying—steel. Midvale is still pioneering today.

We consider that our laboratory is the property of our customers in a very real sense, and it is quite probable that new requirements in manufacture and production have faced you with new problems in the metals you use. We would like to help you solve them. In fact, we may already have done so for other people.

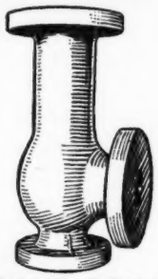
If you do not already have a copy of our catalog on Heat Resisting and Corrosion Resisting Castings, we would like to mail you one today. It is of interest to anyone faced with installation problems requiring resistance to abrasion and corrosion, and gives the chemical properties and composition of seven Midvaloy Heat and Corrosion Resistant alloys. Call the Midvale Company in Philadelphia, New York, Pittsburgh, Washington, Cleveland, Chicago or San Francisco.



RINGS and SPIDERS
Midvaloy rings and spiders—used as parts in heat treating and nitriding furnaces to combat high temperatures and gaseous corrosion.



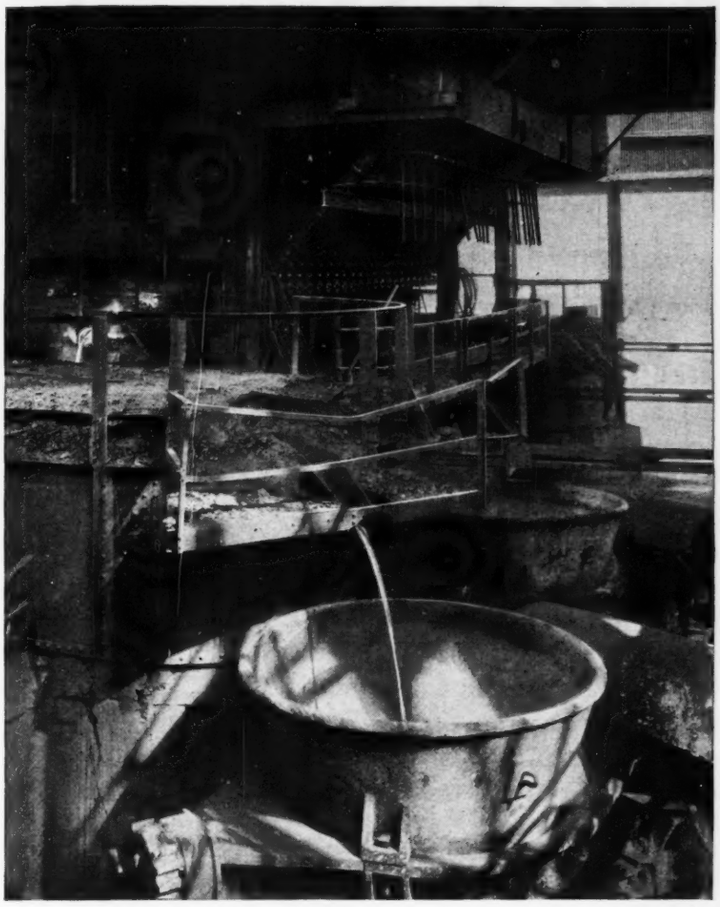
RETORT NOZZLES
Retort nozzles for the chemical industry—to meet a severe corrosion condition.



VALVE BODIES
Valve bodies made for the process or chemical industry to resist acids and corrosion.

FORGED PIPE PLUGS
Forged pipe plugs designed for service on high-pressure and high-temperature cracking stills.

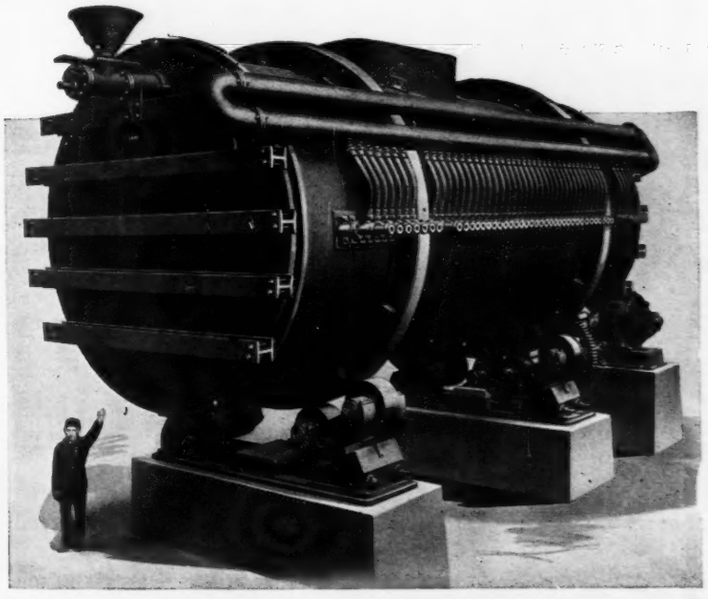
In Every Part of the Plant



- - - *the Copper Industry uses A-C Machinery*

For more than seventy-five years Allis-Chalmers has furnished a large part of the equipment used by copper mines throughout the world. Allis-Chalmers through close cooperation with the men of the industry who improved old methods and discovered new processes contributed to the growth and success of the industry by producing the mechanical equipment necessary in making the new processes and methods commercially operative.

Above: Copper Smelting Furnace
Right: Pierce Smith Copper Converter



Equipment for Copper Mines

Electric Hoists
Ore Sampling Equipment
Smelting Furnaces
Slag Cars
Skull Breakers
Copper Converters
Casting Furnaces
Casting Machines
Crushing Equipment
Screens

Electric Power Generating and Driving Equipment
Motors Texrope Drives Pumps
Blowers and Compressors

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

POWER *works* AGAINST *you*

Power wasted by metallic friction is more than a waste of power-dollars. *It actually works against* you.

Wasted power helps friction, that destructive force, in damaging machinery and in piling up extra production costs—for repairs, maintenance and lubricants.

This is one important reason why inadequate lubricants are extravagance, not economy. Correct Lubrication pays for itself in actual savings on power costs—and usually pays *extra* dividends in lower production costs.

In every type of world industry, Gargoyle Lubricants and Vacuum engineering service have established records for eliminating power waste and keeping production costs at a minimum. The Vacuum representative will be glad to show you operating cost records on the kind of machinery *you* use—*before* and *after* using Gargoyle Lubricants.

Bearings and Their Lubrication, Air Compressor Lubrication, Stationary Steam Engines, Machine Shop Lubrication, Gear Lubrication, Conveyors, Crushers.

We will be glad to send one or all of the above technical treatises on lubrication, to any executive or engineer, if requested on your company letterhead.

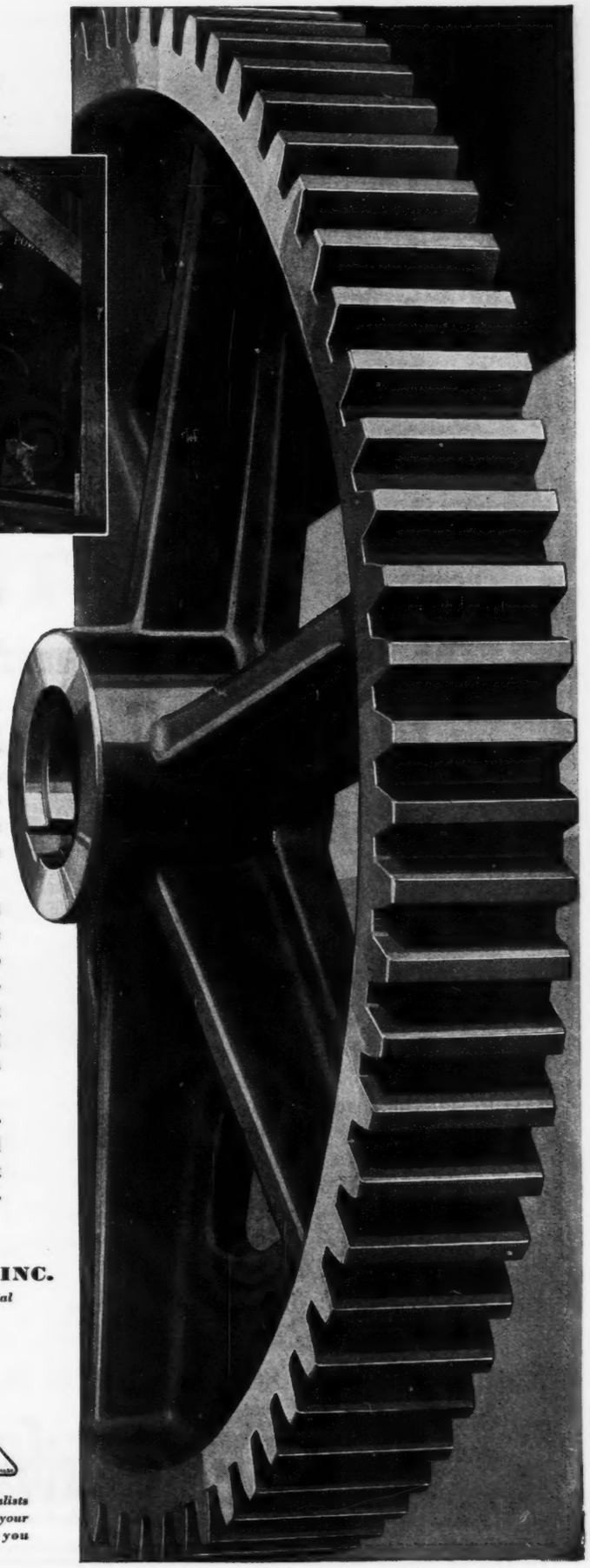
GARGOYLE
Lubricating Oils

VACUUM OIL COMPANY, INC.

61 Broadway, New York City. Branches and warehouses throughout the world.

Large view shows Nickel Cast Iron gear cast by The Brown Clutch Co., Sandusky, Ohio, used in Brown "Giant-Line" Hoists.

Below: *Brown "Giant-Line" Hoist in operation.*



In *Brown "Giant-Line" Hoists* NICKEL CAST IRON *gears "perform better longer"...*

BROWN "Giant-Line" Hoists have won a long-standing reputation for dependable operation in service that places frequent shocks on all gearing. To withstand such exacting conditions all Brown "Giant-Line" Hoists are equipped with Nickel Cast Iron gears.

President O. F. Rinderle, of The Brown Clutch Co., states: "Nickel Cast Iron gears assure the owner of greater strength—greater resistance to shock loads—longer wear; in short, a longer lasting and more profitable investment. Nickel Cast Iron is resulting not only in a beautiful casting to look at but has eliminated even so much as a 'speck' in the finished machined teeth."

Additional assurance of dependable performance in Brown "Giant-Line" Hoists is obtained by using Hercules engines having Nickel Cast Iron cylinder blocks... the longest wearing cylinder material available.

THE INTERNATIONAL NICKEL CO., INC.

Miners, refiners and rollers of Nickel . . . Sole producers of Monel Metal

67 WALL STREET, NEW YORK, N. Y.

Nickel CAST IRON

A BETTER MATERIAL FOR MODERN NEEDS

INCO NICKEL

Our casting specialists will gladly discuss your problems with you

Anaconda

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Andes Copper

Nevada Consolidated

St. Joe Lead

Burma

International Nickel

Hollinger

Chile Copper

Chain-O-Mines

Lake Shore

Broken Hill

Katanga

Miami

Roan Antelope

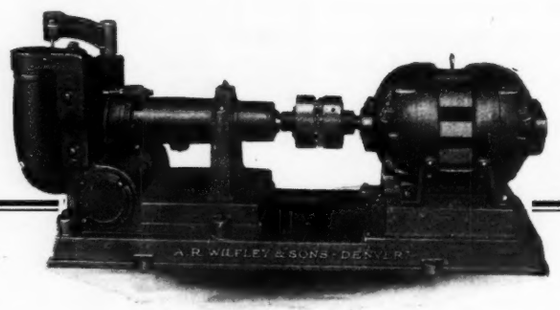
United Verde

CENTRIFUGAL WILFLEY PUMPS

Ask Them

What Sand Pumps They Use

they'll tell you—Wilfleys



TAKE ALL the leading concentrators in the States, write their names on pieces of paper, drop them in a hat and then draw—the chances are 100 to 1 that should you ask that company what pumps it uses for handling concentrates, tailings, milk of lime, etc. it will tell you—Wilfleys.

100 to 1 indicates just about the proper ratio of Wilfley users to non-users. The many companies use this non-stuffing box, low-maintenance pump because they know that pumping costs will be lowest.

Let such popularity, not only in the States but in other countries, guide you in overhauling your mill equipment with the idea of cutting your operating costs. Put in Wilfleys.

A. R. WILFLEY & SONS, Inc., P. O. Box 2330, Denver, Colo., U. S. A.

WILFLEY Centrifugal SAND PUMP

PATENTED

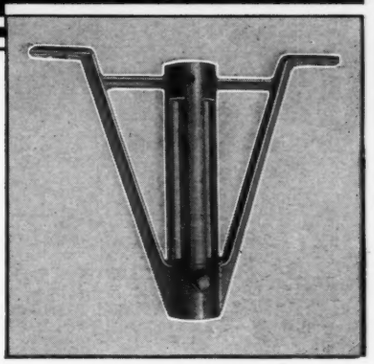
KEEPING DOLLARS *from* WAITING *on* DIMES

To Span YAWNING ROOFS

IT'S NOT EASY to devise a means for securing level trolley suspension across yawning roofs where a good slice of rock or slate has fallen. In the absence of something ready-made, many have been forced to use home-made devices;—at best unsatisfactory and expensive.

Here is something ready-made; a device which saves a lot of fussing and fuming. It is the O-B Pipe Bracket. This new pipe bracket fills the bill easier and cheaper. Just bolt it to the roof; cut the proper length of pipe; screw on adapter and hanger—and the job is done. The trolley wire may then be strung level, neatly, and permanently.

If you are interested in saving the time of blacksmiths and electricians for more productive work than that of making home-made schemes to span these yawning roofs, you will find freedom from a needless expense in the O-B Pipe Bracket.



O-B Pipe Bracket

Comes in two sizes: for 1½-inch pipe, and 1¼-inch pipe. Made of O-B Flecto Malleable iron. Page 19, O-B New Products Supplement No. 4 gives full information about this bracket.

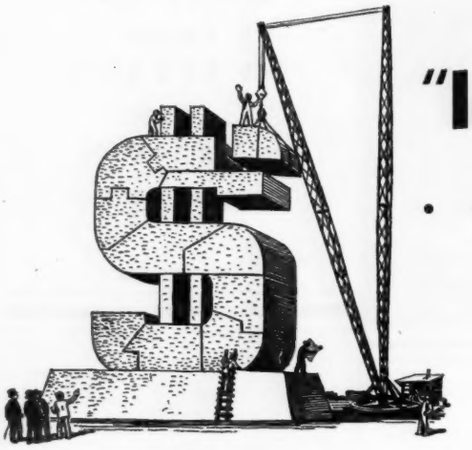
OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Company Limited, Niagara Falls, Canada

1413M

Ohio Brass Co.

NEW YORK PITTSBURGH CHICAGO CLEVELAND ST. LOUIS ATLANTA DALLAS
PHILADELPHIA BOSTON LOS ANGELES SAN FRANCISCO SEATTLE

PORCELAIN INSULATORS
LINE MATERIALS
RAIL BONDS
CAR EQUIPMENT
MINING MATERIALS
VALVES



"Improved Net Earnings for 1932 . . . *how can we build them?*"

■ ■ ■

"HOW can we build our 1932 net earnings?" Executives and engineers of many mining and metallurgical enterprises are asking themselves this pertinent question.

Many, too many, still try to answer it by enforcing sweeping curtailments of all avoidable expenditures. Those with more business acumen are pushing through intelligent investments in new production machinery offering high returns through *reduced operating costs.* In many fields of business, mining included, nothing will go farther towards improving 1932 *net earnings* than money spent wisely for securing every justifiable modern operating economy.

These are Golden - Opportunity Days for both the operating official and the engineer to locate and apply new aids to lower costs around mine, quarry, mill, smelter and refinery. Farseeing directors were never more receptive to expenditures insuring definite and substantial return from added capital invested to restore or improve yesterday's profit margins—even to the extent of borrowing added capital or buying "on time" in order to realize logical new economies that might otherwise lag too far into the future. Installment purchases with this objective in view constitute a progressive and economically sound trend of the times.

Throughout 1932 thoughtful and successful mining men the world around will be in the market for everything that can help them build improved *net earnings.* Thoughtful manufacturers of machinery and equipment related to this primary concern of the machinery user will do well to interpret—both in their field sales work and advertising — the values of their product in meeting this operating problem. No more logical sales appeal can be adopted in the interest of both user and seller. No more constructive message for the advertising page can be presented.

The Publishers

THIS IS THE HOME of Bear Brand Xanthates. From here the first commercial shipment of Xanthate ever made went out in 1923 to serve the mining world and establish a new standard of efficiency in flotation recoveries. From here the mining world still gets as fine a grade of Xanthate Flotation Reagents as you can buy. Here research is going on today for even better Xanthates, which a greater mining world will need tomorrow.

Bear Brand Xanthate Flotation Reagents

Great Western Electro-Chemical Co.

9 Main Street, San Francisco

Plant: Pittsburg, California

Cable Address . . . "Chlor"

INTERNATIONAL SMELTING COMPANY

New York Office: 25 Broadway

Purchasers of

GOLD, SILVER, COPPER, LEAD
LEAD-ZINC ORES and CONCENTRATES

Ore Purchasing Departments:

818 Kearns Building, Salt Lake City, Utah—Miami, Arizona

ANACONDA
from mine to consumer

Copper Smelter: Miami, Arizona

Lead and Copper Smelters: International, Utah

Custom Lead-Zinc Concentrators: International, Utah; Rico, Colo.

Refineries: Raritan Copper Works, Perth Amboy, N.J., and International Lead Refining Company, East Chicago, Ind.

MERRILL DEPENDABLE PRODUCTS

NORDSTROM VALVES
"MERCO" COMPOUND FOR THREADS AND GASKETS
MERCO NORDSTROM VALVE CO.

MERRILLITE ZINC DUST
THE ALLOYS COMPANY

MERRILL-CROWE PRECIPITATION PROCESS

MILLS-CROWE CYANIDE RECOVERY PROCESS

SILVER-DORFMAN PROCESS

MERRILL CLARIFYING FILTERS

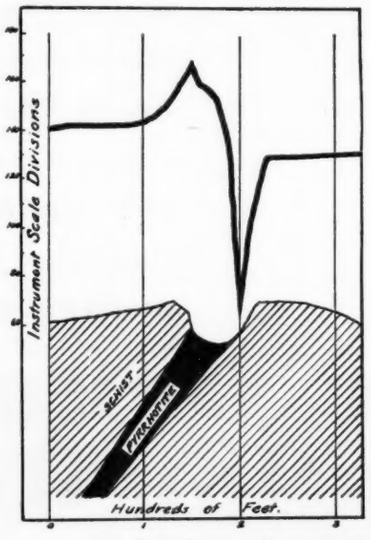
MERRILL SLIME FILTERS

THE MERRILL COMPANY
343 Sansome Street . . . San Francisco
Cable "Lucro"
....Subsidiaries....
The Alloys Company
Merco Nordstrom Valve Co.
MERCO

The Hotchkiss Superdip

For Rapid Magnetic Exploration

Sensitive—Simple—Swift—Strong



Magnetic Profile across a Pyrrhotite Ore Body in the Ducktown Basin of Tennessee.

For description and specifications address

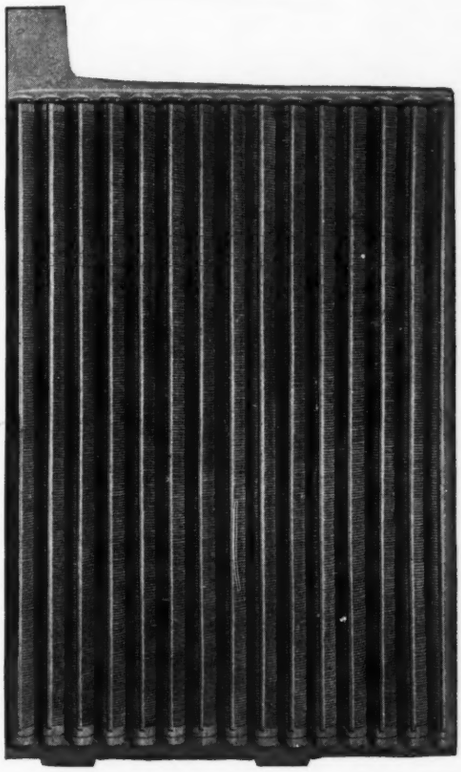
W. C. McBRIDE, Inc.
704 Shell Bldg., St. Louis, Mo.

Geomagnetic and geological surveys under the direction of Noel H. Stearn, Geologist

MINNESOTA REPRESENTATIVE—
Holman I. Pearl
First National Bank Bldg.
Crosby, Minnesota

WEST COAST REPRESENTATIVE—
Elmer W. Ellsworth
P. O. Box 658
Stanford University, Calif.

The inside story of the EXIDE-IRONCLAD BATTERY

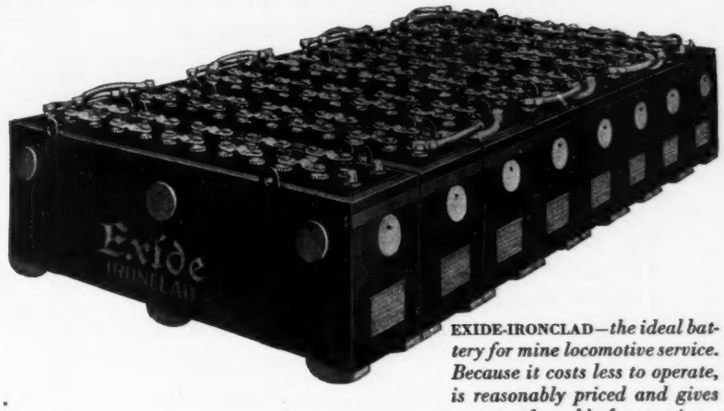


Why it is economical, dependable and long-lived—even in the toughest kind of mining service

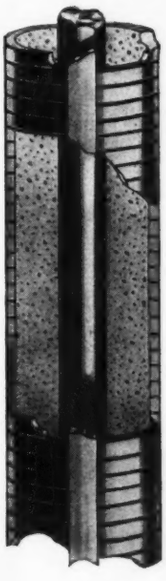
THE Exide-Ironclad Battery has a construction different from that of any other battery. Not made different just to be different, but a superior construction that is the result of 43 years' battery-building experience.

That the Exide-Ironclad is a battery that costs little to operate, can be depended on for plenty of reserve power for steep grades and extra-heavy loads, has an exceptionally long life—is being proved to owners every day. They know Exide-Ironclads in their trammers and locomotives need no pampering . . . that they cut costs per ton mined.

And an Exide representative will show you, too, in black and white, that this is so. Why not have one call and discuss your electrification problems with you? Or send for booklet, "Facts." No obligation either way.



EXIDE-IRONCLAD—*the ideal battery for mine locomotive service. Because it costs less to operate, is reasonably priced and gives years of trouble-free service.*



Above—ONE OF THE REASONS *for the exceptionally long life of the Exide-Ironclad Battery. The positive plate; showing slotted rubber tube construction. There is not another battery made that has this money-saving construction.*

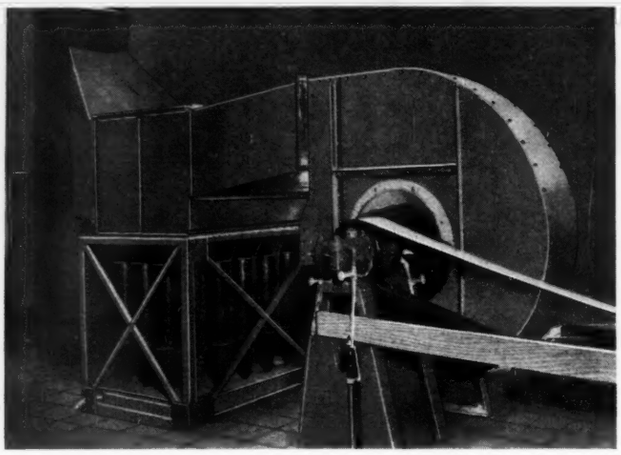
At left—A CLOSE-UP *of one of the finely slotted hard rubber tubes of which the positive plate is composed. The active material is imprisoned in the tubes yet allows free flow of the electrolyte (liquid) in and out. This means a long, active life.*

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto



Multiclone
DUST COLLECTORS

The Multiclones shown in the above illustration are removing dust from exhaust gases from a furnace roasting zinc ore. The efficiency is over 90%, and most of the material escaping the Multiclone is fume. Each unit is collecting approximately one ton of dust per day. (The photograph does not show the dust hopper, which is located on the floor below.)

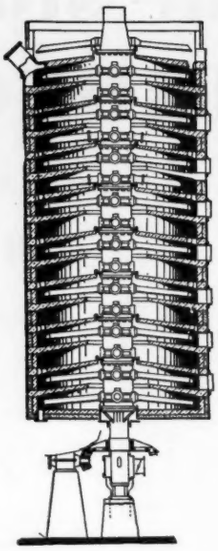
Some Features of the Multiclone

Turbulence reduced to minimum . . . Collected dust mechanically removed . . . Small amount of floor space required . . . Unit construction facilitates handling, installation, and the adding of additional capacity . . . Maintenance and operating costs minimum.

If you have a dust problem, and are losing valuable material by dusting—or, if you want to lower the cost of dust collecting and improve your present production methods—write for the complete story of the Multiclone.

■

WESTERN PRECIPITATION CO.
CHEMICAL ENGINEERS
COTTRELL ELECTRICAL PRECIPITATORS
MULTICLONE DUST COLLECTORS
PEEBLES SPRAY DRIERS
1016 W. NINTH ST., LOS ANGELES
NEW YORK OFFICE: 405 LEXINGTON AVE.
LODGE-COTTRELL, Ltd., George Street [Parade], Birmingham, England



NICHOLS HERRESHOFF FURNACE

ENABLES producers to attain the economical limit of smelting. Its success at many of the world's notable metallurgical plants testifies to its definite, practical advantages in operation, capacity and adaptability. Our engineers are at your service for assistance in solving any roasting, calcining or drying problem.

NICHOLS ENGINEERING AND RESEARCH CORPORATION
New York

PACIFIC FOUNDRY COMPANY, LIMITED
San Francisco

1 to 50 Tons Capacity

Automatics!

(Dump 20 a minute without labor!)

The Quality of Our Wheels is Superb

(Try us on Repair Wheels or Trucks)

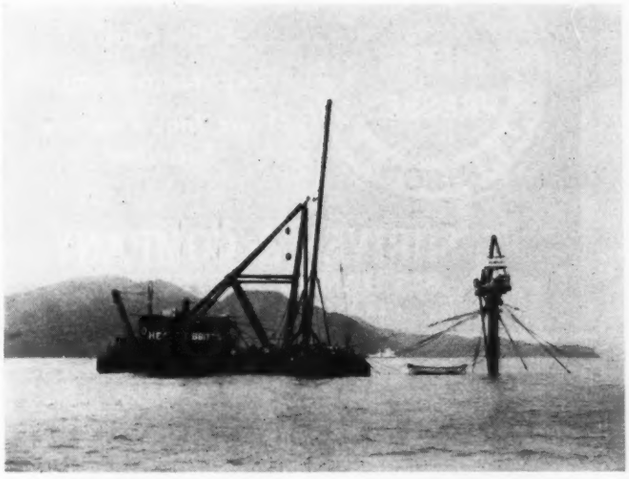
Other types of Ore Cars

Sanford-Day Iron Works, Knoxville, Tenn.

FINEHARD FACTS *

Finehards Find The Way for San Francisco's Bridge

over the Golden Gate



Diamond drill and crew of D. G. Longtin Diamond Drill Company, 621 De Young Building, San Francisco, California . . . drilling 1,300 feet from shore in San Francisco's celebrated Golden Gate

To exactly determine foundations for pier locations for any bridge or large structure . . . *no more accurate instrument exists than the diamond drill* . . . It gives a true and accurate picture of formations and the core is actual tangible proof as to whether or not the rock will support immense weights and stresses.

Mr. Dan G. Longtin, diamond drill contractor, 621 De Young Building, San Francisco, California, states that in proving pier sites for the Golden Gate Bridge he diamond drilled one thousand (1,000) feet in thirteen (13) different sites across the Golden Gate under unusual conditions — water from fifty-five to one hundred feet in depth and with a swift running tide to combat. Two inch cores were taken throughout — the *diamonds* used were FINEHARDS *exclusively*.

*This is the fourth of a series of advertisements relating actual experiences with *Finehards* throughout the world.

No rock too hard—No formation too difficult
Your core drilling can be done with Finehards
CHEAPER — — MORE CORE — — FASTER

THE VAN ITALLIE COMPANY
Exclusive Agents in the U. S. A. and Canada for J. K. Smit & Zonen (Dealers in Industrial Diamonds Since 1888), Amsterdam, Holland
90 WEST BROADWAY, NEW YORK, N. Y., U. S. A.

THE VAN ITALLIE COMPANY
90 West Broadway, New York City, New York

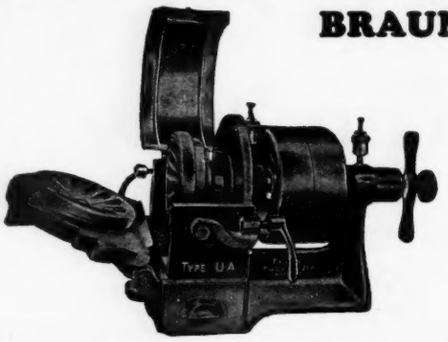
Please send me your "Handbook of Finehards" . . . which describes FINEHARDS and the new method of Finehard Diamond Drilling . . . which is cheaper and more efficient.

Name..... Title.....

Address .....

PULVERIZING YOUR LABORATORY SAMPLES with speed in the

BRAUN Type UA Laboratory Pulverizer



Straight drive without gears, grinding ¼-in. material to 100 mesh with one grinding. Bearings easily removed and replaced. Plates of special alloy. Installed and considered indispensable in every modern laboratory.

Price F.O.B. factory, Los Angeles **$135.00**

BRAUN CORPORATION, Ltd.
2260 E. 15th St., Los Angeles, California
Manufacturers of BRAUN LABORATORY APPLIANCES
San Francisco House, Braun-Knecht-Heimann Co., Ltd.

YUBA

leads in dredge improvements. This has been made possible by the wide experience of Yuba engineers in all countries. Send all your dredging problems to Yuba.

Yuba Manufacturing Co.
351 California St., San Francisco
California, U. S. A. 3108

T. SHRIVER & CO. FILTER PRESSES HARRISON, N.J.

FILTER PRESSES
Filter Cloth
Diaphragm Pumps
Your Inquiries are Solicited

T. SHRIVER & COMPANY
826 HAMILTON STREET
HARRISON, N. J.

WELLMAN

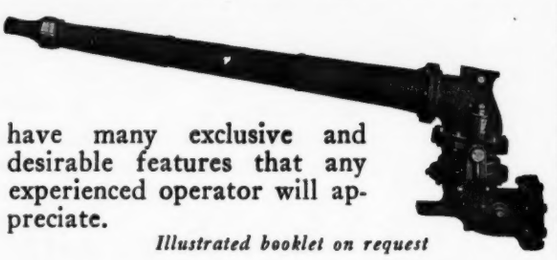
Mining Machinery

Turn to Wellman Engineers for a profitable solution of your problems.

Hoists, Tipples, Skips, Cages, Car Dumpers (all types), Filling and Excavating Bridges for Leaching Vats, and Special Machinery.

THE WELLMAN ENGINEERING CO.
Formerly The Wellman-Seaver-Morgan Co.
CLEVELAND, OHIO

Climax Hydraulic Guns



have many exclusive and desirable features that any experienced operator will appreciate.

Illustrated booklet on request

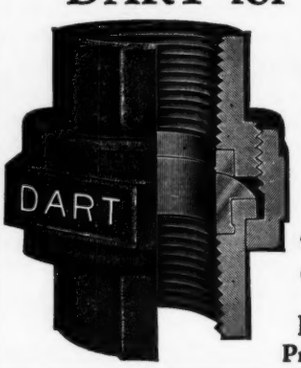
GEORGIA IRON WORKS, AUGUSTA, GA.
Manufacturers of Hydraulic Guns, Sand and Dredging Pumps

H & K SCREENS

Perforated Metal, the ideal screening medium for Jigs, Trommels, Vibrating and Shaking Screens, accurately made by perforating specialists.

THE HARRINGTON & KING PERFORATING CO.
5641 Fillmore St., Chicago, Ill.
NEW YORK OFFICE: 114 Liberty St.

DART for Durability



Two Bronze Seats machined and ground to a ball-joint, in combination with heavy pattern malleable iron pipe ends and nut is why Dart Unions give years of satisfactory service.

Free samples on request.

The Fairbanks Company, Sales Agents
Canadian Factory: Dart Union Limited, Toronto

E. M. Dart Mfg. Co.
Providence R. I.

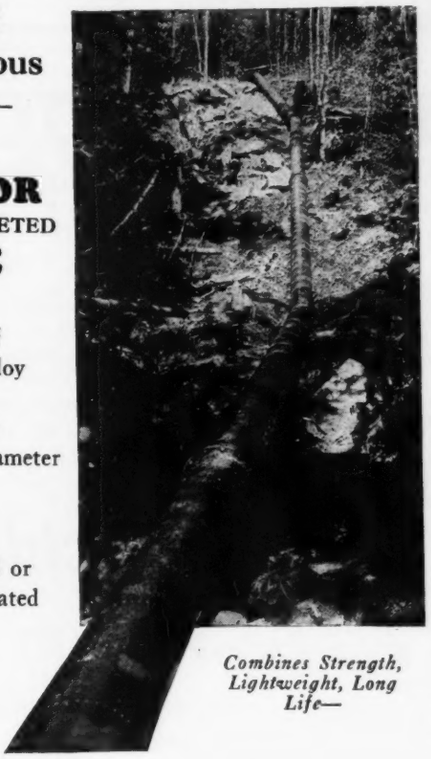
Years of Continuous Service—

TAYLOR
SPIRAL RIVETED
PIPE

Made of
Copper-Alloy
Steel
in Sizes
3 to 42-in. Diameter

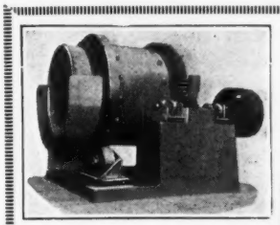
—

Galvanized or
Asphalt Coated



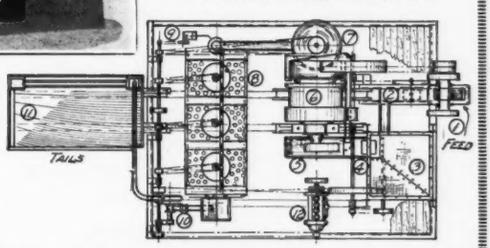
Combines Strength, Lightweight, Long Life—

TAYLOR FORGE & PIPE WORKS, CHICAGO
Box 485, Chicago — 50 Church St., New York



RIB-CONE
PORTABLE PLANTS
STANDARD STEEL FRAME
OR "FRAMELESS"
Write for Bulletin No. 130.

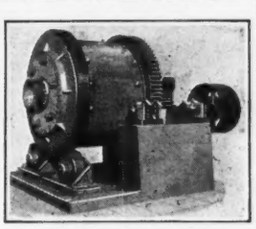
Amalgamation, Concentration, and Flotation in every possible Combination!



Straub complete manufacturing facilities, located at *seaboard*, plus 30 years' experience, enable us to furnish plants at the prices you should pay. Modern, up-to-the-minute design, and the liberal use of high-grade alloy steels instead of obsolete cast iron saves useless weight, freight and power charges. Rib-cone mills and crushers are manganese and chrome fitted. We make every major item in our plants except flotation cells and engines. We manufacture—not assemble. There's only *one* reasonable profit in our prices.

Straub flexible design permits amalgamation, concentration, flotation, etc. in any and every combination. Plants furnished with steel framework, or for timber framework when you can make this locally.

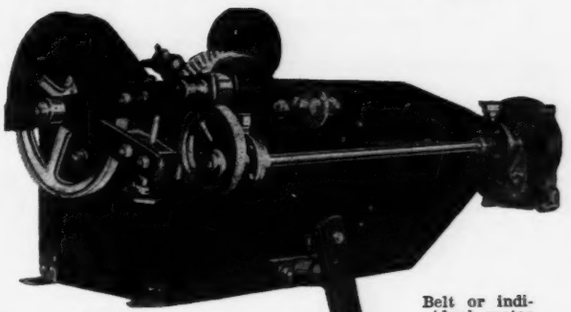
"Anywhere a mule can go!"



STRAUB
MANUFACTURING CO.
507 Chestnut Street
Oakland, California

AUTOMATIC SAMPLER No. 2

for individual installations

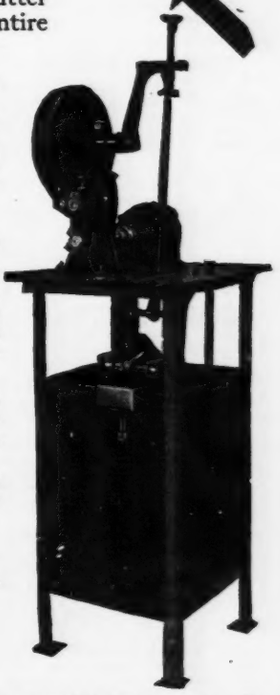


Belt or individual motor drive.

Simple, Inexpensive and Positive

This sampler is widely used for taking wet or dry samples regularly and accurately at various key points in milling and concentrating processes. Sampling intervals may be varied for any period from 10 to 60 minutes. Entire mechanism enclosed in moisture-proof housing. Cutter maintains same speed for entire stroke.

Used by Anaconda, Nevada Consolidated, Kennecott, Walker, Silver Dyke, International, Cananea, Magma, Mesabi, Aluminum Ore, Granby, Chief Consolidated and many other prominent producers.



Geary Reagent Feeder

enables users to save on flotation reagents and obtain accurate control of processes. Feeds any liquid reagent properly and accurately. Can be regulated from ½ cc. to 1300 cc. per minute. Entirely automatic.

Used by Anaconda, Phelps Dodge, A. S. & R. Co., Inspiration, Nev. Consol., Am. Metals, Tenn. Copper, etc., etc.

We also manufacture Geary Lime Feeder and Geary-Jennings Sampler (Master switch control).

REPRESENTATIVES:

Mr. Chester H. Jones, 52 Vanderbilt Avenue, New York, N. Y.

Ammex Equipment Co., Inc., 406 San Francisco St., El Paso, Texas

Mr. L. C. Cooley, 75 E. Wacker Drive, Chicago, Ill.

R. P. Ross & Co., Sudbury, Ontario, Canada.

Hosking & Hylton, Fulwood House, High Holborn, London, W. C. 1, England.

THE GALIGHER CO.
Established 1901
SALT LAKE CITY, UTAH

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 5 cents a word, minimum $1.00 an insertion, payable in advance.

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 to 3 inches.....$5.50 an inch
4 to 7 inches..... 5.25 an inch
8 to 14 inches..... 5.00 an inch

Rates for large spaces, or yearly rates, on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. E.M.J.

Copy for New Advertisements received until Dec. 18th for the issue out Dec. 28th

EMPLOYMENT SERVICE

IF YOU are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service established twenty-two years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 264 Main Street, Buffalo, New York.

MANAGERS, superintendents, other important men in mining industry have engaged us for thirteen years to negotiate connections. Individual. Confidential. Jacob Penn, Incorporated, 535 5th Ave., New York.

POSITIONS WANTED

ENGINEER, American, age 28, speaks Spanish, available immediately for permanent connection. Two years' experience mine shift boss, one year exploration and development, year and a half mine surveyor. Good on maps. Excellent references. School of Mines graduate. Box 613 Bonne Terre, Mo.

MANAGER or superintendent, by engineer with wide experience in successful gold mining operations. Has thorough understanding of every detail pertaining thereto. Metallurgy, construction, power development, mining, engineering. Sound judgment. Good record. Speaks Spanish. Age 40. Employed. Married. PW-282, Engineering and Mining Journal, 883 Mission St., San Francisco, Calif.

BUSINESS OPPORTUNITIES

INQUIRIES solicited from corporations interested in raising capital through marketing corporate securities. The Brookworth Co., Inc., 110 East 42nd St., New York.

NEED CASH for completing cross cut tunnel with depth under proven lead-silver-zinc ore veins in Coeur d'Alenes. H. C. Myers, Forest Grove, Oregon.

SALARIED POSITIONS

in mining and metallurgy, U. S. and Foreign, secured by an effective system of technical employment, known thru 27 years of prestige and responsibility. Your inquiry will command prompt attention.

World-Wide Employment System, Inc.

421 U. S. Nat'l Bank Bldg., Denver, Colo.

NOTICE:

To Prospective Clients of Employment Agency Advertisers

Employment agencies advertising in these columns agree to refund in full, immediately, any advance commission paid by clients if demand is made any time prior to receipt by client of notice of his employment for a specified position with a specified employer and the client's specific acceptance thereof, terms of any contract signed by clients notwithstanding. *(This notice does not apply to Employment service companies.)*

Searchlight Department
Engineering and Mining Journal

WANTED

Wanted—CRUSHER

In good condition for fine crushing. 2½ in. material down to ⅜ in., forty to sixty tons per hour, Symons or equal. Give price, condition, location.

W-288, Engineering and Mining Journal
330 West 42d Street, New York City

FOR SALE

FOR SALE

Thousands of items of good used equipment consisting of Jaw, Gyratory and Roll Crushers; Ball, Tube and Hardinge Mills; Rotary Kilns and Dryers; Dorr and Oliver Thickeners and Filters; Classifiers; Sweetland and all types of Filter Presses, etc. Shops at Newark, N. J., cover six acres.

CONSOLIDATED PRODUCTS COMPANY, Inc
13-19 Park Row, New York City

The
SEARCHLIGHT
SECTION
OF
ENGINEERING
AND MINING
JOURNAL

Represents the shortest distance between two points—the SELLER and the BUYER. It is the recognized national center for the sale or purchase of good used and surplus new equipment. The advertising rate is moderate and the results are usually more than satisfactory.

Address

SEARCHLIGHT DEPT.
330 West 42d St., New York

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in each McGraw-Hill paper:

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Bus Transportation
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Electric Railway Journal
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1—Braun Laboratory Type Jaw Crusher.
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3—No. 8 Allis-Chalmers Style "K" Gyratory Crushers.
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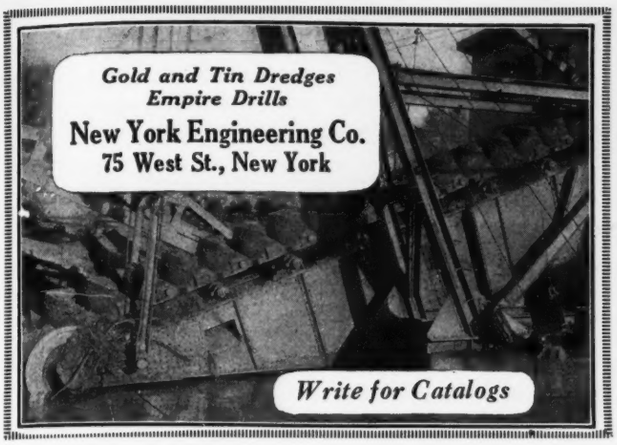

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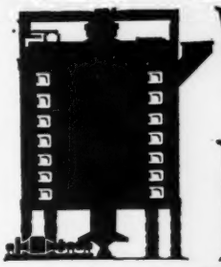
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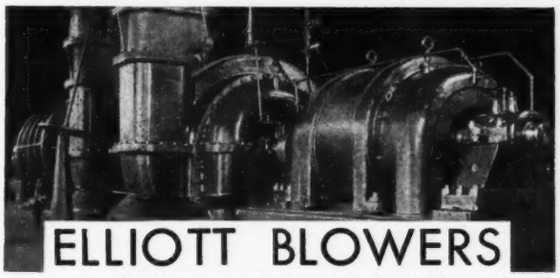
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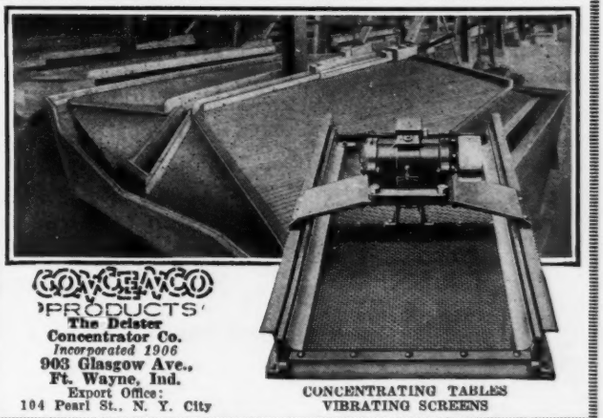
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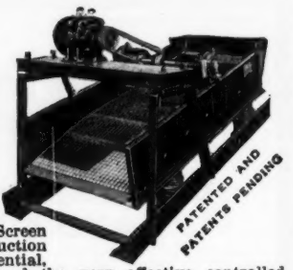

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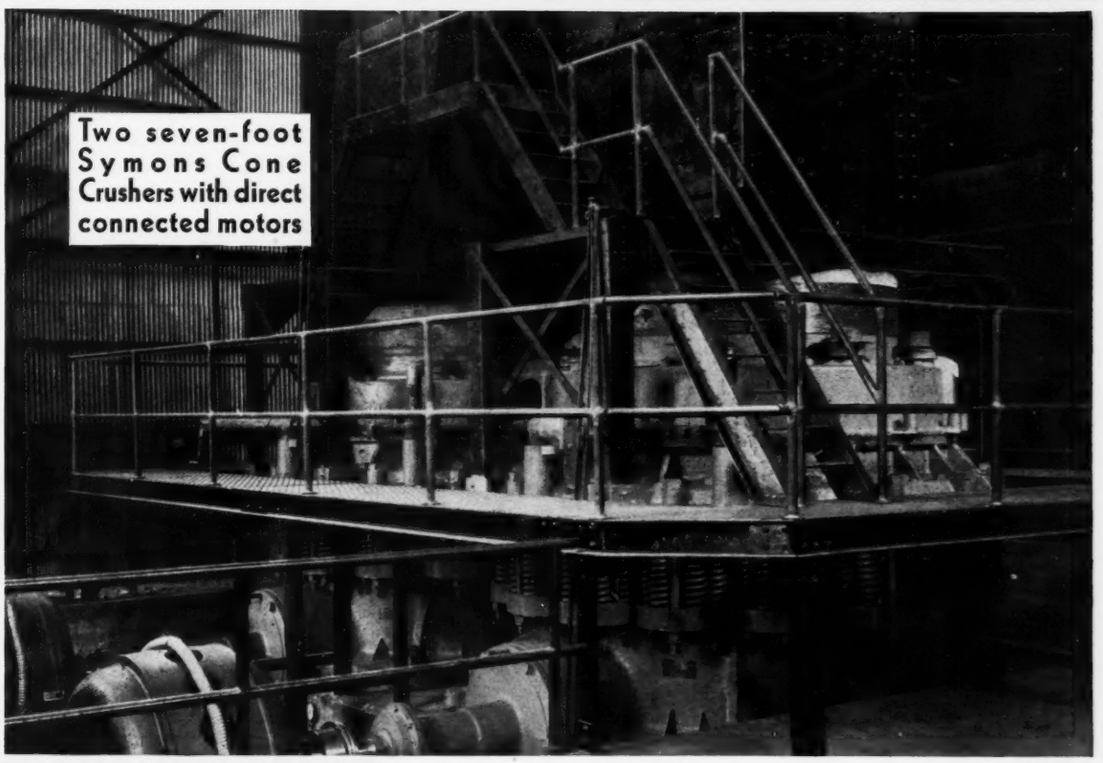

Two seven-foot Symons Cone Crushers with direct connected motors

Again, Symons Cone Crushers have been installed by another of the larger mining companies. These two seven-foot Crushers have recently been placed in service in the new crushing plant at the Ellison Shaft of the Homestake Mining Company at Lead, South Dakota, one of the World's leading producers of gold. This is just one more evidence where Symons "Cones" have been chosen by those who are in a position to recognize their merits.

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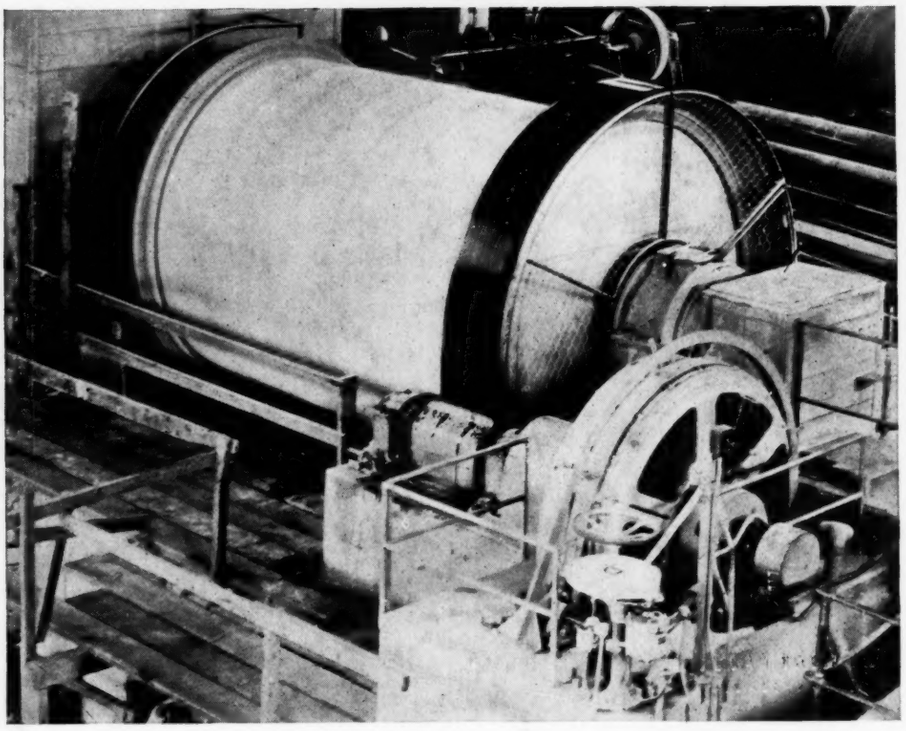

Another tough job that Timkens licked!

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